VOL. LII. — No. 6. **Municipal Engineering** JUNE, 1917.

The World's Leading Municipal Publication

MONEY FOR MUNICIPAL CONSTRUCTION

States and cities which have much work to do have been having some difficulty in letting contracts this spring because, first, they are not willing to pay the increased interest on money needed to pay for the work, and second, because they are not willing to pay the increased cost of the work. These conditions are both of them temporary and will shortly be overcome, mainly, it must be confessed, by overcoming the inertia of the governing bodies who will soon fall into line and pay the increased prices, but also in part because the present unsettled conditions will improve and prices will find their proper levels in part in obedience to the law of supply and demand, in part because illegitimate control of prices forcing them to abnormal heights will be prevented, and in part because the unsettled feeling of the moment will be changed as the new conditions are recognized and allowed for in our daily life.

State and municipal bonds are not subject to income tax, and this fact in itself will make them popular to investors beyond most other bonds except the national loans. Just now the Liberty loan must first be taken up and we are all patriotic enough to put our money there first. But for many months almost every cent of money raised by this loan will be expended in this country and it will be back immediately into the channels of trade, ready for new investment. And "municipals" will keep their advance position as the favorites for safe investment, good for long time or readily salable on the market when the need comes. Notwithstanding the plentiful supply of money, the influence of the interest rates on government loans and the chances for making (or losing) large sums on projects made necessary or fostered by the war will keep the rates of interest on municipal bonds at a somewhat higher level than in the past, and we must accept this along with all the other increases in price which are due primarily to the greater abundance of money in all its forms and its consequent shrinkage in value as compared with the really stable general average of values of the staple commodities.

Contractors have had to raise their prices to meet increased cost of materials and labor, but there is no prospect of any material reduction in the general run of uncontrolled prices, and the work must be done, so that the governing bodies will find it necessary, as stated above, to make up their minds to pay the increased cost. Nor can they be accused of improvidence in doing this, because they can see no reasonable prospect of a reduction in cost of work until long after the structures have been put into use and possibly until they have been worn out.

To be sure there are some abnormal conditions which make certain materials and apparatus too high in price in some localities, and it may be necessary in such cases to control the situation by refusing to invest until either lack of business or official control of such illegitimate ways of making profits brings the prices down to the proper level. But this will be done and the work will go on.

Notwithstanding the great expansion in many lines of manufacturing, due to the war and to the trade arising from the present conditions, it is therefore certain that the municipal field, including state, county, city and town improvement, is a most promising field for investment and for work, and it will be but a few months until the tide of municipal improvement will reach a height heretofore undreamt of. Now is the time to take advantage of this certain prospect and make ready to take care of the great business which will soon be overtaxing all the facilities for it now in existence.

POSTAL ZONES FOR PUBLICATIONS

The zone system for paying postage should make Indianapolis, the railroad center nearest the center of population in the United States, the greatest publishing center in the world for magazines and papers of national circulation, for it will be able to mail its publications at a much lower cost than any other city under the plan which, at the time this is written, has passed one House of Congress. But Indianapolis is not selfish and is joining in the protest against this discrimination in favor of local publications, this penalizing of subscribers at a distance from the point of publication. For the increases in rates for long distances are so great that the magazines must in self-defense pass on the increase to the subscribers. Otherwise, with the increases in mail rates added to the enormous increases in cost of paper and of labor, many of them must go out of business.

There is less reason (except as to volume of business) for applying the zone system to second class mail matter than to first class matter.

Protest may still be effective in stopping the passage of this feature thru the other House. If not, the full rates do not go into effect for a year, and there is another chance with the next session of Congress. The friends of the free and equal dissemination of knowledge, all of whom are directly interested, must get busy or this injustice will be perpetrated. It certainly cannot be perpetuated. The evil results will show too plainly. Meanwhile many of the best mediums, and therefore not the most popular, will be forced out of existence.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

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THE MAINTENANCE OF BITUMINOUS PAVEMENTS

By the Editor.

This article opens with some descriptions of special forms of bituminous road construction crowded out of last month's article, which is followed by a brief discussion of the subject of oiling roads.

The principles of ideal asphalt pavement repair work are developed and some practical hints are given regarding the nearest possible approach to these ideals in the work on the street.

Little attention has been given as yet to the technical specifications for repair work of any kind, and a few brief suggestions are made concerning the repair of bituminous pavements other than asphalt.

THE following descriptions of two special forms of bituminous surfaces used to some extent in Massachusetts are from a paper by Wm. D. Sohier, chairman of the Massachusetts State Highway Commission. The first is a mixture of sand and tar for a wearing surface, adapted from the practice of City Engineer Brodie, of Liverpool, England.

Sand and Tar Surface.

We have heated our sand and tar on the roadside, using tar kettles and a sand heater to heat the sand. We built a box on wheels, sloping to the end, and had a flexible pipe with a flat nozzle from which the tar and sand mixture was poured into the road.

In Natick, where some work of this character was done in 1914, the old macadam road was scarified, about 2 inches of 2½-in. stone was spread and rolled; this was grouted with the tar and sand mixture, finer stone rolled in, etc., and the cost was about 75 cents a sq. yd.

The road has been most satisfactory, and it certainly looks now as if it would last for ten years at least, on a road with about 50 trucks a day and over 700 motor vehicles.

We have used this method of construction on quite a number of stretches of road, especially on grades, as it seems to be less slippery for horses than any other type of bituminous surface, especially if the surface coat is left off and the stones are allowed to project a little.

The tar and sand seems to stiffen and strengthen the whole road, and we believe the use of the sand prevents the tar from oxidizing for many years, and thereby adds to the life of the road.

We developed this year a very good contrivance for securing an even distribution of the mixture. Two plank bridges were made that bridged the road. They were 2-in. plank supported in the middle on a 2-in. plank on the crown of the road and built up on the sides. Another 2-in. plank running lengthwise of the road was supported on these, and the man pouring the mixture walked along this plank, held his bucket right against the plank and walked at a rate of speed that just emptied the bucket in the length of the plank. A flat-nosed bucket was used, with a nozzle about 8 inches in width.

By placing the bridges the right distance apart, one bucket covered just the proper area, and we poured about 2 gallons to each sq. yd. of surface.

Keeping the bucket against the edge of the plank secured a straight edge on the road. The plank was then moved along on the bridges across the road, and the process repeated until the whole width was done. There were practically no spaces left where the voids were not filled, and the bitumen did not lap.

By keeping the same men on the pouring and having the hot mixture brought to them, uniform results were insured and the work progressed rapidly.

In England, in several instances, I think in all where they were rolling either a sand-pitch grouted road, or grouting with tar a stone road, they were wetting the wheels of their roller. In one or two cases they had a man on each side constantly pouring water on the roller wheels. This was to prevent the tar from picking up on the wheels of the roller.

In Liverpool, they make a little ordinary water box and place it over the wheel of each roller. In the bottom of the box they leave a little opening on one side, and put in a piece of crash or linen toweling, which hangs down over the roller wheel and keeps it just moist, the roller man filling the box from time to time with water. They say it does not need much water but merely enough to keep the wheels of the roller damp, and when they tried other methods they got too much water and it interfered with the hot tar surface, pitting it. The box is just the width of the roller wheel, about a foot to 14 inches square. When they used too much water, they got blowholes in the tar.

Gravel and Asphalt Surface.

The second special form of construction used in Massachusetts is a mixture of gravel and asphalt for wearing surface which Mr. Sohier describes as follows:

In Shirley, Mass., a road, 18 feet in width with 3-ft. shoulders, was built, the curves being banked and widened to 21 ft. A gravel foundation was put in wherever the bottom was bad, and about 4 inches of local crushed stone was spread and well rolled.

On this was spread, as evenly as possible, about 3 inches of a bituminous mixture, made of gravel that had been run thru the crusher, and sand or stone dust, mixed with a heavy asphaltic product.

The gravel and sand and the asphalt were thoroly heated and were mixed in a hot mixer, and then carted onto the road and spread. The surface was rolled down to about 2 inches in thickness, when the mixture was sufficiently cool not to crawl under the roller.

Great care is necessary to insure a uniform product, uniformly heated, mixed and spread, and that sufficient asphalt is used and no more than sufficient to bind the mixture properly.

The quantity of asphalt has to vary somewhat, according to the amount of voids in the mineral aggregate. The varia-

DISTRIBUTING TARVIA ON WEARING SURFACE.

DELIVERING TARVIA X HOT FROM CENTRAL PLANT BY MOTOR TRUCK.

SPRAYING TARVIA B ON ROAD SURFACE.

tion is usually from 18 to 22 gallons of the cold asphalt to the cubic yard of gravel. When the mixture is right it has about the consistency of brown sugar, and compacts under the roller, tho when it is first spread and rolled it sometimes has a few hair cracks which the traffic soon rolls out. The asphaltic product used in this work has a penetration of from 80 to 120 with a Dow penetrometer.

Roads constructed of sand and asphaltic oil were first tried by my Commission in 1905, and that road is still in existence, tho it has required a considerable expenditure each year, to keep it up, renew and widen it.

The gravel and asphalt mixture was first tried by me in 1907, and that piece of road is still in reasonably good condition.

Such mixed asphalt gravel roads certainly look as if they would last for a considerable period of time. Several quite long stretches have had already five years' wear. A few, but not many, weak places occur, and these have to be patched, but the expense is very slight.

With the higher wages, the higher cost of all materials, etc., the cost of all road construction has increased.

I am giving below a few of the costs of roads of this character. These costs are all for the 4-in. broken stone base, rolled, with a 3-in. mixture spread on top and rolled to 2 inches. The grading, foundation, if any, drainage, etc., were all additional.

Cost—Gravel-Asphalt Mixture.

Shirley	(1914)	$0.81 a sq. yd.
(Residuum asphalt, 8 cents a gallon.)		
Sterling	(1914)	$1.01 a sq. yd.
Gloucester	(1916)	$1.29 a sq. yd.
Andover	(1916)	$1.20 a sq. yd.
Reading	(1916)	$1.08 a sq. yd.

The asphalt used was a residuum asphalt, usually one with some lake asphalt in it. It cost 9½ cents a gallon to 12½ cents a gallon, depending on the quality.

We used a penetration of about 85 for this character of road.

Bitustone.

Bitustone double bond pavement is a Warren Brothers Company product which is different from asphaltic concrete on cement concrete base or the thin bituminous layer on cement concrete base in that the cement concrete base is left somewhat open in texture, particularly in its upper portion, so that the double bond cement, a mixture of hot bituminous cement and fine sand, fills the voids in the cement concrete and flushes to the surface to receive a thin layer of fine stone chips to form a slight mat wearing surface.

Experimental Bituminous Pavements.

A road which is neither a concrete road nor a bituminous concrete road is the so-called concrete road with bituminous wearing surface, the first development of which was the dolarway pavement, patent on which was not obtainable. It is a concrete pavement with a very thin bituminous top and has appeared in various parts of the country, the most successful development being that on state highways in California. But even there, where conditions are most favorable, the thin bituminous coat, not over ⅜-in. thick, wears off or breaks off in large areas and the concrete on some roads is soon bare. A thickness of bituminous top of about 1½ inches seems to be necessary to reasonable permanence of the bituminous top.

The National pavement is a mixture of asphalt with clay for a wearing surface which has been under trial for two or three years. Reports of its success are not yet definite enough to warrant full description of the methods of construction at this time.

One patent on an asphalt pavement mixture starts with crusher run stone with 1½ inches maximum size, to which is added enough fine sand, if any is necessary, to bring the proportion of fine material up to 6 to 10 per cent. To this mineral aggregate is added from 25 to 40 per cent. in volume of sawdust, which is intended to reduce the voids still further by means of a fine material which is compressible. Ten per cent. of hot asphalt cement completes the mixture. This is the product of a practical asphalt contractor of long experience, but as the pavement is scarcely two years old its value is not yet demonstrated.

Fibered asphalt pavement is made by mixing a treated wood fiber with asphalt and some stone dust to produce a wearing surface which has some good points. No cushion coat is necessary, as the fiber in the mixture prevents creeping or rolling. Cracks are not frequent for the same reason. This pavement is now three or more years old and while the pavements laid have not all of them been successful on account of the lack of careful study of the methods and materials for mixing and laying, and the possible absorption of moisture if chips are used instead of fine fiber, the pavement gives promise of success if it can be properly developed under scientific study and experiment.

Oiling Roads.

The oiling of roads is not for the purpose of making a pavement, but simply to suppress dust and make the surface of the road waterproof. There is much difference in the detail of operation with difference in the material and some materials, such as sand, require the mixture of clay or loam to give the road material more stability before the oil can be used successfully.

A mixture of water and oil makes a mush which is very objectionable and it is necessary, therefore, to drain and grade the road so that water can not get in to mix with the oil or with the oiled road material. This means a thoro grading and shaping of the road surface so that water falling on it will run off readily, and adequate ditching so that water will not stand in the sub-grade. Also any ruts or holes formed by traffic in the surface must be filled and oiled so that rain water will not be worked by traffic into the oiled mixture.

While the oil is used mainly as a prevention of dust, it should not be applied on a dusty road. After the surface has been made smooth and uniform, it should be compacted by rolling and the oil then applied. If the surface is uniform enough and will shed water easily and promptly, any slight depressions should be filled, and then the loose dust should be well swept off, leaving a clean earth surface on which to apply the oil. The mending of the road should be carefully done, scarifying the spot where new material is to be added if necessary to bind the new with the old, and then tamping or rolling the soft spot down until it is as hard as the rest and makes a smooth uniform surface. The Illinois state highway engineers prefer a sprinkling of sand over the surface of the freshly oiled road to take up any surplus oil and prevent sticking to wheels or hoofs, believing that the extra cost is well repaid. Many engineers, however, use the sweepings from the road for a top dressing. About 1 cu. yd. of sand for 100 to 150 sq. yd. of surface will be required.

Application of the heavier oils on a dusty road is likely to form a mat which does not adhere to the road surface beneath and rolls up on wheels or creeps or breaks up, destroying the value of the treatment. Putting the road dust back as a top dressing may have the same effect to a less extent. These effects are not so pronounced with the lighter oils, until their lighter ingredients have evaporated.

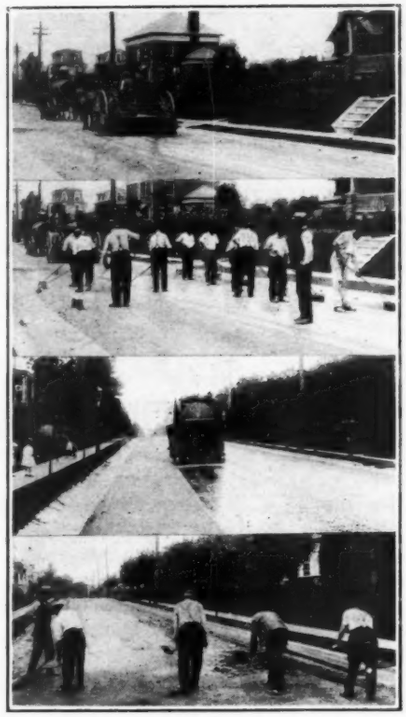
The oil should be applied for a first treatment at the rate of about ½ gallon per sq. yd., and it is much better to put on this amount in two applications with a few hours between them that the oil may have an opportunity to soak in and therefore less tendency to gather in pools, making the oiling irregular and softening the road so that holes will form in the soft spots under traffic.

The oil can be applied by an ordinary sprinkling cart, but much better results as to penetration and uniformity can be obtained by the use of a pressure distributer which drives the oil straight down against and into the surface with a pressure of 15 lbs. in the tank. The distributer is supplied with a pump to give the required pressure, either an oil pump to give the pressure direct or an air pump to keep the oil in the tank under constant pressure. It should also be provided with a heater so that it can be used in cold weather or with heavy oils when they are required. If an automobile truck is used the power for pumping is at hand.

In applying the oil it is specified that great care must be taken not to overlap the strips on which the oil must be applied in order to cover the whole width of the road, and extreme care in getting the oil uniformly distributed. Any spots not covered by the first application must be covered by hand-pouring cans following immediately behind the distributer.

After the first treatment, double as described, later treatments may be with ¼ to 1/3 gallon per sq. yd. if they are not too many months apart. Treatments with ¼ gallon twice a year are much more satisfactory than one with ½ gallon once a year. Indeed, the one treatment very often does not last over the year. If a road has been properly oiled and with sufficient frequency for several years, a single small application per year may be sufficient.

The time for applying the oil varies according to the character of the season. The road should be dry when the oil is applied. April and September are the months preferred if the weather permits, northern climates making some difference in the date on account of late springs.



OILING A MACADAM ROAD IN PHILADELPHIA.
FIRST: SPRINKLING AND SWEEPING WITH HORSE-DRAWN SWEEPER.
SECOND: HORSE-DRAWN SPRINKLER AND SWEEPER FOLLOWED BY HAND BROOMS.
THIRD: PRESSURE DISTRIBUTER APPLYING OIL.
FOURTH: SPREADING STONE SCREENINGS OVER THE FRESH OIL.

For oiling roads paraffine base oils have been largely used. When the oil is reduced by weathering no adhesive material is left and there is no permanent effect produced on the road. Oils with asphaltic base are better because the residuum after weathering still has some beneficial effect upon the road.

There is no very definite line between road oiling and road treatment by the penetration method, one shading off into the other. However, the asphaltic oils and tar are used almost wholly for the bituminous macadam pavements, penetration method, while paraffine base oils and light asphaltic oils are used for oiling roads. The bituminous macadam treatment is applied to gravel or broken stone roads only, whereas, road oiling may be applied to any road surface from the highest class of old macadam road to the earth road which has merely been graded and drained. Even a sand road can be oiled if a heavy asphaltic oil is used first and mixed with the upper 4 or 5 inches of the road under some such program as the following used in Illinois: Apply ¾ gallon per sq. yd. of the heavy oil, cover this with 1 inch of the sandy soil, apply ½ gallon of oil, add another layer of sand, and continue until a sufficient thickness of solid oil and sand crust is formed to carry light traffic.

It must be definitely understood that no oiled road will carry any heavier traffic than the original material of which it is composed.

Hard tire traffic with heavy loads will rut the road if of earth or poor gravel the same as tho the road had not received the oil treatment. The only function of the oil is to

prevent dust and to keep the water out of the road so that it will not be softened by the rains as much as the untreated road would be. The first purpose is attained by oilings as frequently as the formation of dust requires; the second by keeping the surface of the road always smooth and solid by careful and prompt repair of ruts and holes and application of oil to small areas in which the oil disappears more rapidly than in the road generally.

The following quotations from W. Huber, Assistant Engineer in the Ontario Department of Public Highways, sum up the principles of road oiling a very clearly and concisely.

The different materials used for the prevention of dust and for the preservation of the road surface have been classified as non-asphaltic oils, asphaltic oils and refined tars. If the material to be selected is expected to contribute in any degree to the binding of the road surface the choice will lie between asphaltic oils and the refined tars. The non-asphaltic oils may serve the purpose of dust layers, and, if applied with sufficient frequency, may do much to protect the surface, but their effects are at best only temporary and except for the protection which the road has received in the meantime, it is no better at the end of a period of treatment than at the beginning. Therefore the non-asphaltic oils must be considered only as dust preventives.

On the other hand, the asphaltic oils, i. e., those oils having as a base a certain amount of pure asphalt, are more than dust layers, and each application leaves, on the evaporation of its volatile constituents, a certain amount of asphalt in the road surface to act as an aid to the binder. The greater the asphalt content in the original oil, provided it has been properly applied, the greater will be the permanent benefit derived from its application.

As between the true asphaltic oils and the refined tars of corresponding grades there appears to be little choice, excellent results having been observed from the careful application of either material. Satisfactory results would, therefore, appear to be due not so much to the choice between oil or tar as to the selection of the most suitable grade and to the methods of application.

Summing up, success in oiling and tarring roads will depend on many factors, principal of which are the original condition of the road, the care with which it is cleaned prior to treatment, the selection of the most suitable grade of material, the weather in which the work is done, the temperature to which the oil or tar is heated, the quantity in which it is applied, the protection from traffic of the freshly treated surface, the proper covering with suitable material to take the wear, and finally on the careful maintenance of the treated road. The fulfillment of these requirements demands no special technical knowledge, but it does demand extreme care in the preparation of the road surface, the selection and handling of the materials, and the maintenance of the road after treatment.

When a city or county has much road oiling it is worth while to put up a 10,000 or 12,000 gallon oil tank with heating coils and manholes. If it can be located near a city power plant or a factory from which steam can be obtained when needed, this will be most convenient and economical. But if such a location is not available, a boiler, stationary or portable, can be purchased also, or a tractor or roller can be run up to the tank to furnish the required steam heat to make the oil light enough to pump readily. A rotary pump will give good service. An ordinary pump for a water tank can be used, and if power is not available an ordinary hand lift pump can be used for oils light enough to be pumped cold or at low temperatures.

Steam heat will raise the temperature of the oil up to 150 or 175 deg., sufficient to make any road oil easy to pump.

June, 1917.

Repairs of Bituminous Pavements.

The subject of repair of bituminous pavements has never been treated fully in publications or specifications. When repairs are made by contract the result is specified and occasionally the kinds of apparatus permissible and not permissible are defined. When made with a municipal plant the methods of doing the work are prescribed by the superintendent of the asphalt repair plant or the foreman of asphalt street repairs, who may or may not be an experienced and competent man. The consequence is that asphalt repairs are too often failures and the lives of good pavements are shortened by ignorant efforts to replace breaks and cuts, which produce elevations or hollows, soft spots or hard spots, doing little toward stopping the disintegrating action of traffic upon the good asphalt surrounding the original break and holding their own surfaces for but a brief time.

The original system of guaranteeing asphalt pavements for a series of years is still continued in most cities and where the amount of work is sufficient to warrant close attention results in reasonably good repairs made by the contractor during the period of the guaranty.

High cost and frequent poor quality of repairs made by contract after guaranties had expired led to the establishment of municipal asphalt plants for repair purposes in cities having yardage of asphalt pavements sufficient to warrant them. The number of such plants is increasing each year, and some of them have developed into construction plants also. The first of such plants were standard stationary plants, such plants being considered necessary for good work.

The demands of the smaller cities for asphalt pavements, and the impossibility of establishing stationary plants in such cities, led to the design and construction by manufacturers of portable plants which began with a plant constructed on two railroad cars with some additional construction alongside for use with the plant when in operation. The sizes of plants have been gradually reduced, sometimes without reduction in capacity, thru two-car plants, practically self contained, and one-car plants of like nature, to the modern road asphalt plant, which, while of less capacity, can turn out one kind of mixture at a time at a very satisfactory rate.

These improvements in the adaptability of asphalt plants to small amounts of work have materially extended the use of asphalt and related bituminous pavements in the smaller cities and have made possible the establishment of small private and municipal repair plants to take care of repairs promptly and efficiently, provided they are in charge of competent men.

Besides these regular plants there are several outfits for preparing asphalt pavements for the new material required for repair which, when supplemented by some apparatus for supplying the new mixture required, are doing quite satisfactory work. Some of these also supply the mixture. Some of these will be mentioned more in detail later.

The repairs necessary on asphalt pavements may be placed in a general way in two classes. One class includes surfaces

RESURFACING OLD BRICK PAVEMENT WITH ASPHALT. AUSTIN MOTOR ROLLER IN BACKGROUND.

which have become irregular by wear or minor movements of the material in the wearing surface. The other class includes breaks, cracks, areas in which rolls or shoves have taken place affecting the whole asphalt surface, and depressions caused by settlement of the foundation.

If irregularities of the first class can be corrected without taking up the whole pavement, material is saved and probably, also, labor and time. The obvious way of doing this is to heat up the asphalt surface until it is soft and fluid enough to be raked up, supplied with the necessary amount of new material to fill any depressions, smoothed off and rolled down into place. The Perkins heater was invented early in the history of asphalt pavements to perform this service. It consists of a series of gasoline burners under a hood which directs the hot flame and gases of combustion against the asphalt surface. When carefully operated this machine does very good work. The flame sets the surface asphalt on fire and burns it, and if the flame is made hot very quickly the asphalt below does not absorb the necessary heat before the surface is burned off. Experience with the operation of the machine and expertness in determining from observation when the asphalt is properly heated and how much of it must be raked off to be sure to get down to the uninjured mixture below are essential to good work with the machine. Many more yards of pavement than are actually repaired may be injured or put in the way of rapid injury by traffic by putting the operation of the machine under a foreman with poor judgment and little or no experience. This accounts for the prejudice against the direct heat process which exists in some places.

Several attempts have been made to devise a machine which would discharge hot air and combustion gases against the surface of the asphalt, thus simply heating the asphalt without danger of burning it. This requires a larger machine because large quantities of air must be heated very hot and discharged under some pressure against the asphalt surface. The Lutz asphalt repair plant is the ultimate development along this line, and is doing very satisfactory work at costs reported as quite low, not only for this class of repairs but for those of the second class described farther on. A portable plant for supplying the mixtures, called the Equitable, having one drum, or having two drums so that both binder and surface mixtures can be turned out at the same time, is supplied to accompany the surface-heater, or to operate alone. The Hooke asphalt repair plant is a small asphalt kettle plant of special design used in a number of cites. The manufacturers of asphalt paving machinery also supply such small plants for small asphalt repairs.

In repairing defects of the second class it is economy to go as far as may be necessary to reach the seat of the trouble. If it was due to settlement of the foundation, cut entirely thru the concrete and remove enough material to determine whether any additional settlement is possible. Compact the sub-grade thoroly by flushing or tamping, and put in new material which will compact well to take the place of any unsatisfactory material removed. Use concrete for the filling if the cavity is not too large. If the settlement is in an old trench or excavation, carry the cut along its length far enough to reach well solidified material, then widen the cut in the concrete so that the new concrete, when placed, will bridge the trench and form a sort of arch over it, being supported by and against the solid ground on each side of the trench. Place the new concrete and tamp it well into place, leaving the top surface even with the surface of the old concrete around the edges of the excavation and uniform so that the asphalt top will be of uniform thickness.

After the concrete has set and is ready to receive the wearing surface, or if it has not been necessary to cut into the concrete, sweep out the opening thoroly and clean up the edges of the asphalt, cutting them so that the sides of the opening will be vertical. Cut back until the edge shows good material and the top shows that there is plenty of good material behind it. The cuts should be rectangular, not rounded, and the sides fairly straight. A sharp cutting instrument which will not shatter the adjoining surface is necessary. It is quite common to cut the edges sloping, but this leaves a feather edge of the new material which may make an outline of the patch, whereas if the edges are cut vertical and the patching is well done the patch can hardly be distinguished from the original surface after a few days under traffic. Carefully paint the edges of the cut with asphalt cement so that the old surface is all covered with a thin coat, thick enough to cement the old and new together but not thick enough to make an appreciable joint between the two.

The opening should then be filled, first with the cushion coat, well tamped into place, and then covered with enough surface mixture so that when thoroly rolled the patch will have a surface uniform with the old surface surrounding it; neither depressed so as to be pounded by heavy traffic nor elevated so that the traffic will pound the old pavement on the sides of the patch and thus form new holes.

To produce the best results the mixture used in the old pavement should be known and the new mixture should be

STREET REPAIR GANG OF GARY, INDIANA, REPAIRING CONCRETE STREET BY FILLING CRACKS WITH ASPHALT. ASPHALT IN BARRELS ON WAGON AT LEFT. AUSTIN MOTOR ROLLER. ASPHALT HEATING TANK AT RIGHT. HOT WAGON FOR TOOLS IN REAR.

PROPER METHOD OF PREPARING ASPHALT STREET FOR PATCHING. PAINTING EDGES WITH ASPHALT CEMENT IN MIDDLE GROUND. AUSTIN MOTOR ROLLER IN REAR.

the same, except that the old pavement is probably harder than when laid and so somewhat stiffer asphalt cement should be used so as to make the new mixture when compressed conform with the hardness of the old pavement.

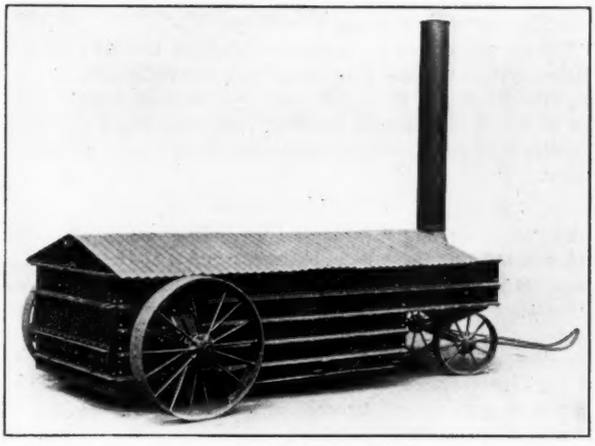
No repair work should be done in wet weather or in weather so cold that the old surfaces of heater patches will get cold before the new material is applied or the new material will get cold before it can be thoroly rolled.

The above gives the ideal conditions under which good patching can be insured. When a city has laid pavements for many years under the variations which have been made in specifications and with the variations in materials used by different contractors and at different times, it will not be possible to vary the mixtures sent out from a central plant to suit exactly the variations in conditions met in a single day's work, or even in the work covered by a single load. For this reason a good portable plant can sometimes do better work on account of the possibility of varying the mixture in each batch, to suit the conditions immediately before the gang.

Again, old pavements may be so worn down that it will be impossible to use the two layers and a single layer may be better to use. Too frequently surface mixture only is used in patching and this is almost as frequently the reason why the next patching of the street is largely the replacing of the previous patches with enlargements due to the deterioration of the old pavement next adjoining them.

Cracks are sometimes patched by filling with a fine soft mixture instead of by cutting out and replacing completely. This practice is liable to result in a larger and wider patch the next time instead of a patch which will last for a reasonable length of time. Nothing is more exasperating to traffic than a series of transverse cracks imperfectly repaired so as to give a series of thin ridges to pound over.

While the ideal conditions of repair work are seldom attainable, an expert foreman can and will approximate them closely by varying his treatment and thus make patches of fairly long life, if they are not equal to the original pavement. Sometimes foremen pride themselves on making patches which are better than the original pavement. While this is better than patches much poorer than the original, they are liable to increase the rate deterioration in the old pavement and thus shorten the period until the next patching. When a pavement is very old and patches are large, an entirely new surface is thus obtained in the course of two or three years at the expense of the repair fund and to the relief of the construction fund or of the property owners who would pay for a new pavement. The result is a pavement more irregular and less durable than a new pavement and more or less economical according to the relative costs of patching and of new surfacing.



IROQUOIS ASPHALT REPAIR WAGON.

Saving Expense in Garbage Collection

A STUDY OF ACTUAL CONDITIONS IN BILLINGS, MONTANA

By John N. Edy, County Surveyor, Billings, Montana

Billings, Mont., is apparently an average city as regards its methods of garbage and refuse collection. The author of this paper reports the results of an investigation which showed that the cost could be cut in two by the adoption of proper methods and apparatus. Nearly every one of the smaller cities in this country can do almost or quite as well. This article is therefore of great interest to them all, and it goes into the practical details so that they can learn just how to go about it. Billings collects by means of city teams. Where collections are made by contract the saving would probably be still greater.

THE city of Billings, Mont., has provided five garbage collectors who use two-horse, tight-bottom, box-like wagons, having capacities of about three cubic yards. Some of these wagons have low, and others high, wheels. The five drivers cover different routes, collecting from the residential districts once each week, from the rooming-house districts twice each week, and from the business district daily. Manure is collected with the garbage. The accumulations are hauled to the city dump, which is located inside the city limits and within a half mile of the business district. This dump is less than 200 feet from the main line of the Southern Pacific Ry. and is in plain view of passing trains. A dump man is provided to assist in unloading the wagons, burn all combustible materials, guard against danger from fire, etc.

Sometimes the drivers are assisted by prisoners from the city jail. At times it is necessary to use extra garbage teams, the regular collectors not being able to keep up with the work. The drivers collect everything, accepting all kinds of refuse, no matter where or how stored.

The entire cost of this garbage handling is paid out of the general fund. In one year this cost, including extra teams, was approximately $12,000.00. Of this amount regular teams cost $9,400.00, dump man $1,000.00 and extra teams $1,600.00. The city has very little co-operation on the part of the taxpayers.

The Local Study.

By the definition set out in the ordinance, "garbage" includes all forms of waste matter, such as kitchen refuse, ashes, cans, crockery, paper, boxes, grass, weeds, manure, etc. Small dead animals are also included. Any article or substance (except night-soil), that the householder or business man wants to be rid of is placed in, or more often near, the garbage receptacle and removed by the city. Our investigation was therefore directed against the methods and cost of present methods of handling these many individual accumulations.

The conditions are such that only by the hardest work are the drivers able to keep their routes in good condition; and every man in the department is plainly anxious to assist in placing it on a basis of economy as well as efficiency.

There are three subdivisions of this general subject; viz., collection, hauling, or removal, and final disposal. We undertook to ascertain,

1. The weight of garbage handled, by collection districts.
2. The methods of storing individual accumulations.
3. The cost of collection, removal and disposal.

From the information thus obtained we expected to determine whether or not the present method is satisfactory and economical. Also, as particularly regards the removal of manure, we wished to know how many head of stock contribute to the general bulk of refuse enjoying the free haul provided by the city.

Weight of Garbage.

As collections in residential districts are completed in six days and in other districts in a shorter time, we had but to weigh each load for a period of six days to ascertain the total weight handled in one week. The first weighing began on Sept. 30, with results shown in accompanying table:

WEIGHT OF GARBAGE HANDLED SEPT. 30-OCT. 6.

Date	Driver No. 1. Lds.	Wgt.	No. 2 Lds.	Wgt.	No. 3 Lds.	Wgt.	No. 4 Lds.	Wgt.	No. 5 Lds.	Wgt.
9-30	3	10930	3	10135	4	6120	4	9976	4	7705
10-1	3	8715	3	10035	4	7715	3	7655	4	8190
10-2	3	8810	3	10645	4	7100	4	7180	4	5955
10-3	2	8135	3	8880	4	5965	4	9770	4	7470
10-5	3	9445	3	10450	4	8420	4	12010	4	9530
10-6	2	8845	3	8860	4	8125	3	7555	4	10645
Totals	16	54880	18	59005	24	43445	22	54145	24	49495
Average Wgt. per load		3430		3275		1810		2460		2060

Total loads, 104; grand total weight, 260,970 lbs. (130.5 tons).
Average weight per load, all loads considered, 2,510 lbs.
Weather good; condition of streets good. All weights net, in pounds.

It must be remembered that garbage accumulations of early fall are not likely to represent a fair average for the entire year. The weights above noted are somewhat below the actual of summer, the vegetable season, and of winter, the season of ashes. Perhaps this applies more to the residential districts. Although we may expect the business districts to show some difference, that difference may not be so marked.

It happened that on October 10th Billings celebrated its annual "clean-up" day, when the community made an extra effort to clean yards and adjacent public property. While but one day was officially designated for this clean-up, the process covered a period of several days. In fact, the Street Commissioner had extra teams engaged for the whole week ending October 17th: and by that time we thought the city was pretty clean. It is therefore interesting to compare the results of the first weighing with those given in the second table showing the weights hauled in the week following the clean-up week.

WEIGHT OF GARBAGE HANDLED, OCTOBER 19-24.

Date	Driver No. 1 Lds.	Wgt.	No. 2 Lds.	Wgt.	No. 3 Lds.	Wgt.	No. 4 Lds.	Wgt.	No. 5 Lds.	Wgt.
10-19	2	6230	3	8880	4	8230	4	9040	4	7645
10-20	2	8515	3	10075	4	6945	3	7495	4	8965
10-21	3	10545	4	9765	4	7465	4	9520	4	9065
10-22	2	6825	3	8375	4	7000	3	7615	4	7435
10-23	2	8125	3	9090	4	7315	3	8000	4	7810
10-24	3	8000	3	9590	4	8280	4	8625	4	8560
Totals	14	48240	19	55775	24	45235	21	50295	24	49480
Average Wgt. per load		3445		2935		1880		2395		2060

Total loads, 102; grand total weight, 249,025 lbs. (124.5 tons).
Average weight per load, 2,440 lbs.
Weather good; condition of streets good. All weights net, in pounds.

It seems quite reasonable to assume that this table represents the weight of garbage under the most favorable conditions. And yet there is so little difference in the totals for the two weighings that we may conclude that the clean-up days did not affect the weight of garbage handled.

The figures given are the net total of all waste matter hauled to the dump.

One must wonder at the the great variation indicated in the average load weights. For instance, the second table shows that driver No. 1 average 3,445 lb. per load, while driver No. 3 averaged but 1,880 lbs.; the average of all loads being 2,440 lbs. No. 1 hauls from a residential district and collects ordinary garbage, refuse and manure. No. 3 serves a portion of the business district only, and his collections include a large proportion of light stuff such as boxes, waste paper, packing, etc. This seems to indicate a greater relative cost of collection and removal in the business district than in the residential districts, and so it does. But the fact that driver No. 3 collects light stuff is not a legitimate excuse for this excessive cost. It is largely a matter of storing and preparation by the storekeeper.

The average load-weight of garbage (2,440 lbs.) is less than one-half the average load-weight of coal hauled over Billings streets under unfavorable conditions, as indicated by reports from six local coal dealers. This condition is chargeable partly to the nature of the material handled and partly to the methods of storing by the householder, but the efficiency of our garbage hauling is at best but 50 per cent., and in one district is as low as 40 per cent.

The minimum weight of all forms of refuse is approximately 18 tons per day.

If manure is not handled with the garbage it is probable that the average weight will not exceed 20 tons per day.

Methods of Storing Garbage by the Householder.

An inspection trip disclosed the fact that, contrary to the provisions of the ordinance, garbage is being kept in the following receptacles: lard cans, water buckets, coal buckets, wash tubs, wooden boxes (varying in size from 1 to 80 cu. ft.), paper boxes, baskets, sacks; and in many instances no receptacle whatever is provided, the refuse being deposited on the ground or thrown broadcast into the alley. No effort is made to separate the several kinds of refuse except that manure is usually kept apart from other materials. We found concrete garbage retainers so built that it is almost impossible to clean them thoroly. Manure boxes are of all kinds and sizes, most of them having no provision for emptying except from the top with a fork. Usually such boxes have no lids. We found that there are but 430 satisfactory garbage cans in use, although the population of Billings must be near 14,500. We found 135 head of stock, privately owned, and about 100 manure boxes contributing to the bulk of handled material. We may say:

1. Only about 20 per cent. of the householders provide satisfactory garbage cans.

2. Of the other types of receptacles provided none is satisfactory and practically all are in violation of the existing ordinance; and it may safely be said that all are more expensive to maintain.

3. Manure is stored in open boxes that are hard to clean; and according to the provisions of the ordinance, manure is being removed by the city at general expense.

Cost of Collecting, Hauling and Dumping.

We come now to the question of actual costs.

First, as to collection: The total loads and weight of garbage vary but little from week to week at one time of year; and as the teams all work eight hours per day, we may assume that a record of one day's performance is a fair average of the time spent in doing the different parts of the work. The following form of report was furnished the drivers and kept by them for one day:

ABOVE: A BILLINGS GARBAGE COLLECTION WAGON ON LOW WHEELS, WITH A LOAD OF LIGHT RUBBISH.

BELOW: THE GARBAGE AND REFUSE DUMP. RAILROAD IN MIDDLE GROUND.

Driver..... Date.....

	—Loads—			
	1.	2.	3.	4.
Began Collection:				
Time.				
St. Number.				
Finished Collection:				
Time.				
St. Number.				
Arrived at Dump:				
Time.				
Left Dump:				
Time.				

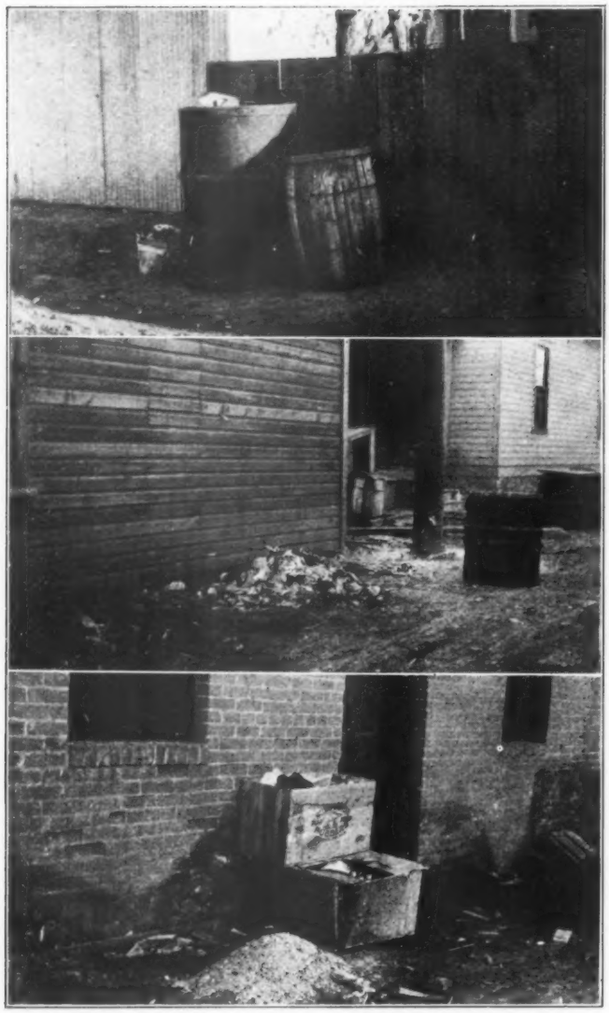
The reports were tabulated in the third of the accompanying tables:

REPORTS OF GARBAGE COLLECTORS, OCT. 8.

		Time in Hours and Minutes			
Driver No.	Load	Collecting	Hauling	Returning	Dumping
1	1	1:10	0:35	0:25	0:45
	2	0:55	(est.) 0:30		0:45
	3	1:20	0:30	0:30	0:35
2	1	1:30	0:30	0:30	0:45
	2	1:00	(est.) 0:30		0:40
	3	1:05	0:30	0:35	0:35
3	1	1:30	0:20	0:15	0:20
	2	1:05	0:20		0:20
	3	1:25	0:20	0:25	0:30
	4	0:45	0:10		0:40
4	1	1:00	0:20	0:10	0:30
	2	1:05	0:20		0:25
	3	1:20	0:30	0:10	0:25
	4	0:40	0:10		0:40
5	1	1:00	0:40	0:20	0:25
	2	0:50	0:20		0:35
	3	1:00	0:30	0:15	0:40
	4	0:45	0:15		0:30
Totals		19:25	7:20	3:35	10:05

5 teams, at 8 hours.....40:00
Collection 19:25
Dumping 10:05
29:30 29:30

To be paid for as hauling..... 10:30
Note that the table shows: Hauling plus Returning equals.....10:55
All the above is regular garbage; no clean-up.



PERMITTED VIOLATIONS OF GARBAGE ORDINANCE. UPPER REASONABLY CLEAN. OTHERS BOTH UNSANITARY AND CAUSING UNNECESSARY EXPENSE IN REMOVAL. TYPICAL OF CONDITIONS IN MOST SMALL CITIES. THEY CAN CLEAN UP AND SAVE MONEY AT THE SAME TIME.

☆

In this table one is quite likely to note two important and unexpected conditions:

1. The time of collection is nearly 50 per cent. of the total time.

2. The time spent at the dump approximately equals the entire time spent in hauling.

These findings were so startling that we undertook to obtain a few short time records of the time spent in collection, so that we might locate the cause of this apparent excessive cost or prove the figures in error. A competent observer was sent out with two different garbage wagons, with instructions to time the drivers in all their operations. Twenty-one blocks were covered in different parts of the city, the reports reading as follows:

SHORT TIME RECORD OF GARBAGE COLLECTION.

I.	Time required to clean block	14 min.
	No. of cans emptied	4
	No. of piles refuse picked up	2
	Total time to empty and clean 4 cans	2 min. 10 sec.
	Total time to clean up 1 pile rubbish	8 min. 30 sec.
	Total time to clean up 1 pile ashes	1 min. 10 sec.
		11 min. 50 sec.
II.	Time required to cover block	7 min. 00 sec.
	No. of cans, 1; time required	0 min. 05 sec.
	No. of boxes, 1; time required	0 min. 20 sec.
	No. of piles, 1; time required	1 min. 00 sec.
	Manure boxes, 1; time required	2 min. 30 sec.
	Clean up around 1 can, time required	0 min. 50 sec.
III.	Time required to cover block	30 min. 30 sec.
	2 men clean one manure box	5 min. 30 sec.
	1 can required	0 min. 30 sec.
	1 can ashes required	0 min. 30 sec.
	1 can, 10 sec; clean up around can	0 min. 50 sec.
	1 pile rubbish picked up	1 min. 30 sec.
	2 men dump box of wet stuff	0 min. 40 sec.
	Pick up small limbs of trees	4 min. 00 sec.
	2 men clean out 4 wooden boxes too heavy to lift	14 min.
IV.	Time required to cover block	15 min. 00 sec.
	Empty 2 cans	0 min. 30 sec.
	Shovel wet stuff from old box	0 min. 40 sec.
	2 men load pile leaves	6 min. 00 sec.
	Empty 6 cans and 2 tubs	1 min. 45 sec.
	Clean up pile ashes (canful)	1 min. 30 sec.
	Clean up pile ashes (canful)	1 min. 40 sec.

Without quoting further from these records it is readily seen that the time occupied in cleaning up around overfull garbage cans, picking up loose piles of rubbish and emptying boxes that are too large to handle is several times as great as the time required to dump and clean the cans.

The total time required to cover 15 of the 21 individual blocks during the progress of the experiment was 203 minutes, or an average of about 13½ min. per block 300 ft. long. Eliminating the manure and allowing 2 cans per residence or 24 cans per block, and assuming that each can may be emptied in 15 seconds,—and this is believed to be a reasonable assumption,—we have 6 min. as the time actually required to empty the cans; and if we allow 2 minutes for the team to walk 300 ft. we have a total time per block of 8 min., as against the present apparent average of 13½ min.

In other words, if the existing ordinance were rigidly enforced as to cans, and manure excluded from free haul, the cost of collection should be about 40 per cent. less than it now is. And the 24 cans will provide for accumulations of ashes and vegetable refuse not being handled at this season of the year. As to the item of collection cost, then, we may conclude:

1. The number and type of garbage receptacles has a great bearing on the cost of collection.

2. It costs at least five times as much to shovel a can of refuse from the ground as it does to dump the contents from the can into the wagon.

3. If the can system for garbage is adopted and strictly enforced, manure and light refuse being collected separately and hauled in a proper wagon, the cost of collection should be decreased at least 40 per cent.

Hauling.

Very little will be said on the subject of hauling; certainly there can be no criticism offered as to the horses engaged in the work. The city teams are all fine specimens of horseflesh and they are admirably well trained. In fact, were it not for the fact that the teams are so well trained, the drivers would have difficulty in covering even less territory.

It has been pointed out, however, that our hauling is only about 50 per cent. efficient, due to the light loads hauled. This is simply another expensive result of collecting all forms of refuse in the same wagon, and, too, of improper preparation of the light stuff by the householder.

In this connection it has been suggested that motor trucks might haul the garbage more economically than teams. This might be true under certain conditions and for some communities: and this feature may be investigated in the future. But for the present I believe team hauling to be more satisfactory locally for the following reasons:

1. There appears to be no advantage, and considerable disadvantage, in using motor vehicles for collection.

2. It would be necessary to provide some central transfer station where the wagons could deliver garbage to the trucks for transporting to the point of final disposal.

3. Rather than provide such transfer station, a, garbage disposal plant seems to be more desirable, both as to economical operation and from the sanitary standpoint.

Dumping.

As to the final disposition of local garbage accumulations, it has previously been stated that all refuse is hauled to the city dump where it is burned. It had never occurred to me, however, that any great time was required to empty the wagons, some of which have been in use about four years. Quite naturally, therefore, we decided to check the results as to dumping time shown in the third table. This was done by providing the dump man with a note book ruled as follows:

Date .....

Name of Driver.	Arrived at Dump.	Left Dump.
	....Time....	...Time...

This record was kept for four days and covered a total of 70 regular garbage loads. All the drivers knew that the record was being kept, tho they did not know for what purpose. The tabulated results of this record are shown in the last of the tables.

DUMP MAN'S REPORT ON UNLOADING TIME. OCT. 12 TO 15.

	Total Dumping Time in Minutes.				
Date.	Driver 1.	No. 2.	No. 3.	No. 4.	No. 5
10-12	35	40	25	35	30
	15	35	20	35	22
	25	20	15	25	20
	..	..	25	20	20
10-13	50	50	25	25	20
	40	25	15	25	25
	...	35	25	20	25
	..	..	35	15	20
10-14	45	35	15	30	30
	35	25	25	25	30
	..	35	20	20	15
	..	..	25	20	25
10-15	20	45	35	25	30
	25	30	25	25	20
	25	40	20	20	25
	..	..	20	20	40
Totals.....	5hr.15m.	6hr.55m.	6hr.10m.	6hr.25m.	6hr.37m.

Total dumping time, 4 days, 70 loads.....31 hr. 22 m.
Average dumping time per day.....7 hr. 50 m.

At the dump is offered the only opportunity for the drivers to loaf. There is no necessity for allowing the teams to rest, as they are never heavily loaded and always return light. The writer believes, however, that the time indicated as occupied in unloading the wagons was actually so spent. In order to appreciate this unusual condition one must watch the performance of this unpleasant and expensive task. The wagons arrive loaded to capacity. The driver first throws off such light material as may be on top of the load: he then uses his fork, his shovel and at times his hands to unload the mass of garbage, crockery, tin cans, ashes, clothing, waste paper and rubbish of all kinds. After observing the accomplishment of this duty one is inclined to the belief that the workmen do pretty well to get the wagon unloaded at all. So there is every reason to believe that the daily time required in dumping garbage is approximately as stated.

It will be noted that the total dumping time shown by the dump-man's report is considerably less than that shown in the table. This is explained by the Street Commissioner as being due to the fact that the drivers were picking up much light and easily unloaded stuff, resulting from the clean-up campaign then in progress, and which the extra teams did not get. The explanation seems entirely reasonable, altho the fact that the time was being recorded may have had something to do with it. At any rate, if we average the two total dumping times we should arrive at a result entirely fair to present methods. We find, therefore, that the average dumping time is 9 hours per day. The rate of pay for garbage teams being 75 cents per hour, this is equivalent to $6.75 per day, not including the time of the dump man. And it follows that for 313 days we have $2,112.75 as the *annual minimum cost of unloading regular garbage teams at the dump.* As no extra teams are here considered, the total actual cost must be greater.

To us this was the most startling discovery of the study; perhaps because it was most unexpected. It is quite evident that the cost of handling garbage does not stop with delivery at the dump. The cost of unloading must be considered.

As to the remedy for this costly and unnecessary condition, it is suggested that a satisfactory type of bottom-dump garbage wagon will solve the problem. These wagons will cost about $175 or $200, and but three or four will be required. In using dump wagons, however, it must be noted that provision should be made for the proper preparation of light, bulky material, such as boxes, waste paper, etc.

It is a simple matter to form conclusions as to the cost of handling garbage at the dump:

1. The present cost is unreasonably excessive.
2. This excessive cost is due partly to the nature of the material handled, partly to unsatisfactory means of storing and lack of preparation by the householder, and largely to the type of wagon used.
3. Under proper regulations as to the points just mentioned and by using suitable wagons, the city can effect a net saving of not less than $2,000 a year on this item alone.

Conclusions and Recommendations.

In viewing as a whole this brief study of conditions affecting the collection and disposal of garbage in Billings, we must conclude that our present system is not only unsatisfactory from the health standpoint, but unnecessarily costly as well. We have seen that:

1. Our collection cost is excessive because proper receptacles are not provided by the householder and because we are handling free of charge a great deal of material that should be cared for at individual expense.
2. Our hauling cost is excessive due to the light loads hauled, which in turn is due to the conditions listed above.
3. Our dumping cost is excessive, due largely to the type of wagon used, and also to the condition listed in (1).

It is entirely proper to ask, What are we going to do about it? I have therefore taken the liberty of offering the following recommendations:

First, Billings needs a new garbage ordinance, one that will be more in accord with progressive methods; and needs to enforce that ordinance without any compunction whatever. I am quite ready to admit my unpreparedness to offer a model. However, the following features should be included:

The can system should be enforced, every householder being required to provide *as many cans as necessary* for the proper storing of all garbage and house refuse. Paper should be baled or tied in bundles so as to be handled quickly and easily. All boxes to be removed, whether wood or paper, should be broken and tied flat. Loose paper had better be tied in paper bundles than placed in sacks, unless the sacks are not to be returned. Manure should be kept in boxes of *approved* design, and removed by the city at the expense of the owner.

There is certainly nothing very harsh about these provisions. The principal objection will attend their enforcement rather than their adoption, as is to be expected. But the cans will cost little; and if purchased by the city and distributed to the householder at cost, such expense will be very slight indeed. The idea of baling or bundling paper and boxes is not new: such a plan will work no hardship on the householder, while it will aid materially in reducing collection and hauling costs. As to the handling of manure, there can be no legitimate objection to charging the individual for special service rendered. Certainly there is a valid objection to paying for such special service out of the general fund. It naturally follows that if the stock-owner pays cash for the

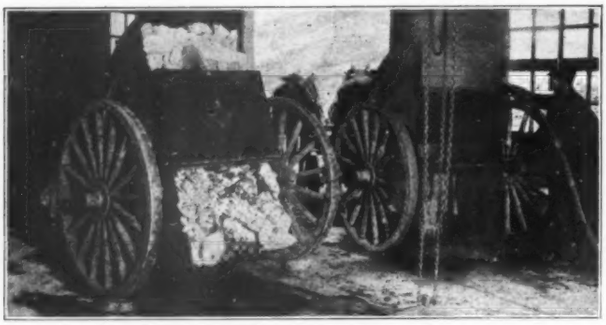
removal of manure he will willingly provide such a box as will be most readily emptied and consequently less expensive to maintain.

What has been said of the can system applies primarily to residential districts. There should be some provision that, where the garbage or refuse from any one building exceeds a certain stated quantity, a receptacle or receptacles of special, approved design shall be provided by the householder or proprietor. In some cases the city might be justified in making a special charge for removing this excess refuse: as, for instance, from large hotels operating heating plants, from printing and publishing establishments, manufacturing concerns, etc. In fact, these large establishments receive special service just as the stock-owner does at present.

Kitchen garbage should be reasonably free from water before being placed in the can.

I believe that except for a few weeks each year, weeds, grass, tree cuttings, etc., can be economically handled with the manure, using a special wagon, one very much like a hayrack but with more nearly tight sides and ends. It might be possible to arrange flaring sideboards for a dump wagon; altho I am not sure that a dump wagon would prove economical for such hauling.

As to the enforcement of a garbage ordinance. Certainly there should be some severe penalty for non-compliance, because the offense is indeed a grave one. A sanitary inspector reporting to the Health Officer all persons guilty of neglect in this respect, would have the most authority and this garbage question deserves the entire time of one man.



A SANITARY GARBAGE CART SUCH AS SHOULD BE USED, WHETHER TWO OR FOUR-WHEELED. GARBAGE WRAPPED IN PAPER, AS SHOWN HERE, IMPROVES SANITARY CONDITION IN GARBAGE CAN AND IN COLLECTION. AT THE RIGHT A CART IS BEING WASHED BY STEAM BEFORE STARTING FOR ANOTHER LOAD.

If efforts along this line are to meet with success, we must secure the co-operation of the individual. A campaign of publicity thru kodak pictures of decidedly unsanitary garbage collections, similar views shown on the movie screen, should tend to waken the public conscience.

Finally, I want to suggest that the garbage be weighed at regular intervals and that some system of reports be exacted from the drivers. It must be remembered that if this policy had been followed in the past this study would have been uncalled for; neither would we be forced to acknowledge the gross waste herein shown.

Final Disposal.

I want to say further that this investigation has been carried on with the assurance that the existing city dump must go. I feel sure that in a short time Billings must and will adopt a more satisfactory and sanitary method of final disposal. The conclusions and recommendations offered in this report apply with equal force to the handling of garbage and refuse in connection with any modern disposal plant. And, the desirability of and real necessity for such a final disposal plant having appeared, the local study has indicated such opportunities for reducing costs that the suggested plant can be installed and paid for in a few years from the savings effected.

In conclusion let me sum up the apparent cash value of the garbage study herein outlined. We know that the annual cost of handling all forms of garbage and refuse, including the hire of extra teams, was $12,000, and exclusive of the dumpman's time was $11,000. Of this amount the regular teams cost $9,400 and extra teams $1,600. Based on the second table we may assume that this regular cost is divided approximately as follows:

Collection	$4,700
Hauling	2,600
Dumping	2,100
	$9,400

If then, as has been outlined, we adopt improved methods, we may reasonably expect the following net saving:

Collection, 40 per cent. of $4,700	$1,880
Hauling, 50 per cent. of $2,600	1,300
Dumping, 90 per cent. of $2,100	1,890
Extra teams, 50 per cent of $1,600	800
Total annual net saving estimated	$5,870

In other words, I believe it is possible for Billings to cut in half its cost of collecting and disposing of accumulations of garbage and refuse.

ORNAMENTAL GAS STREET LIGHTING.

System in a City Engineer's Office

By Manley Osgood, City Engineer, Ann Arbor, Mich.

The office record system and the field system described in this paper before the Michigan Engineers' Society are not as elaborate as some which have been established, but are quite full enough for the purposes of the city engineer's office in the ordinary small city, and are therefore of practical value to many of the engineers among our readers.

THE routine work of our office consists of the engineering for and inspection of sewer and pavement construction, the setting of stakes for contractors building sidewalks on street curbing under either municipal or private contract, the locating of street lines and setting of stakes for grading streets which in years past have been accepted by the city without meeting the present requirements of grading improvement, the cleaning and maintenance of sanitary and storm sewers, the inspecting of plumbing, the numbering of houses, and other miscellaneous work.

Due to the location of the University at Ann Arbor, our organization for this routine work can, during all that part of the year when elasticity is needed, be made quite elastic. One full time man is given charge of all of this routine work, except the sewer cleaning and maintenance and the inspection of construction work, and during the University session as many senior and junior engineering students are employed part time for rodmen and chainmen as are necessary to handle the current volume of work. It is perhaps needless to say, that no such part-time help is used in less than half-day units. During the summer months the volume of this routine work is sufficient to keep very busy a full time party of four men. Effort is made to complete all plans for contemplated sewer and pavement construction during the winter months in such shape that only the setting of stakes for this construction work will be required of the routine work organization during the busier session.

An inspector, full time only, is placed upon each contract construction job, whose duty it is to see that the contract is faithfully carried out and to make a record of such happenings or details of construction as may be of later interest.

Cleaning, flushing and repairing of sewers is assigned to one full-time experienced and somewhat skilled laborer who has one helper most of the time and as many more laborers as are necessary for any particular task that may arise.

One Ford machine is provided for all the conveyance needs of the Department.

No work of any kind is undertaken without the issuing of a regular departmental work-order covering same. These work-orders, in all but minor cases of the most routine work, come to the desk of the engineer and are signed by him. On the form is provided space for a report upon the work at its completion, and this report is returned to the engineer's desk for his inspection before filing. In the interim between the issuing of the order and the completion of and report on the work, these orders are kept, by the employee to whom they are issued in a place provided, where they are readily accessible to the engineer or his clerk in case it is desired to check up the condition of the work or to obtain information from one of them. In issuing these work-orders an attempt is made to designate a definite date by which the work should be completed and to give as fully as possible all general or special information relating thereto.

Forms are provided for ordering any extra work in connection with contract construction or for authorizing any change whatever in the plans or specifications for such work, even tho they involve no extra cost. Inspectors have the most rigid instructions to insist upon the contractor obtaining these respective orders for each individual case which may arise. Such orders must be signed by the city engineer or, in case of his absence, by his principal assistant.

Much work of a special nature has arisen in Ann Arbor within the past few years. Each task has been separately considered and provided for altho much of it has been handled by the routine work organization without interfering with regular duties. Special organizations have, in some cases, lapped over from one special task to another. In work of this nature Ann Arbor is again particularly fortunate, for much of the detail work of such a special job can be assigned to the more advanced engineering students and advice is often gratuitously given by the experts in the various departments of the Engineering College thru their interest in Ann Arbor and their good citizenship.

The filing of the mass of accumulated data in convenient and easily accessible form has received considerable attention. Field note books, permanently bound, are indexed under subject divisions according to street or other location. Thus notes relating to the sanitary sewer in a certain street are indexed in the sanitary sewer division on a card reserved for that certain street. The notes are described by limiting streets, and key information, date of taking, book number and page are given in the description. Notes pertaining to more than one general division are indexed under all the divisions to which they pertain.

A standard size for drawings has been adopted which produces a trimmed blue-print twenty-two inches by thirty-four inches so that it may be neatly folded to an 8½x11 size, that of an ordinary letter sheet. If occasion demands a smaller size, these sheets are halved or quartered or further divided, always maintaining a sheet which will be or fold to the 8½-inch by 11-inch size.

At the time of starting our present filing system, drawings on hand to be filed were of all shapes and sizes. They were accommodated by dividing into eight sizes designated by letters from "A" to "H" inclusive. On account of the equipment in our filing vault, envelopes to accommodate each of these eight sizes were prepared from a heavy Manila paper, each envelope holding not to exceed ten drawings. The subject matter in the files was divided for purpose of indexing and convenience in filing into seven divisions as follows:

I. Sanitary sewer and storm sewer maps and details of sewer standards.
II. Pavement maps and details of pavement standards.
III. Maps of city and large city divisions, such as sections and wards, parks, boulevards, cemeteries, etc.; county, state, and national maps.
V. Plats of small city divisions, additions and subdivisions, and standards.
IV. Railroad, railway and public service corporation maps and maps showing streets, lot divisions, etc.
VI. Public buildings, bridges, and culverts.
VII. Water works and water supply.

Each division was assigned a shelf in the vault and a separate section in the Reference Index. The drawings under any one division and of any one size are given continuous sub-numbers and the envelopes containing these drawings show on the outside the sub-numbers therein contained. Furthermore all drawings are given a designating number. Upon

completion of any drawing this designating number is assigned and a card, bearing this number and a complete description of the drawing, is made. These cards are filed numerically and known as the Numerical Index. A second index known as the "Reference Index" has been prepared and divided into sections according to subject matter as heretofore related.

If now, it is desired to find a drawing of a certain section of storm sewer, Section 1 of the Reference Index is referred to, where on a card reserved for the particular street in question the maps pertaining thereto are described by limiting streets. This Reference Index refers to the index numbers in the Numerical Index and, by turning in the Numerical Index to the numerical numbers referred to, full description of each of the drawings may be had and the one desired selected without extracting more than this one from the envelopes. The cards in the Numerical Index bear the filing data by which each drawing is found. If a drawing has information belonging in more than one of the above divisions it is filed under the major one and indexed under all to which it pertains.

Profiles are on muslin-backed profile paper with a scale of 40 feet to the inch horizontal and 4 feet to the inch vertical. They are made on sheets about five feet long and rolled with about four or five sheets in each roll, arranged, of course, alphabetically. A title in the corner of each sheet indicates clearly what is to be found on such sheet and, due to the shortness of and the uniform size of the sheets, the profile desired can be very quickly and easily separated from the other profiles in the roll. If the profile to be plotted is longer than the standard sheet, the profile is broken and plotted with one section above the other on the same sheet or on as many sheets as necessary. In some cases the profiles of two or three different streets are shown on one sheet, but in all such cases the first two letters in the street name are the same. The 40-foot horizontal scale of these profiles corresponds with the standard scale for plans and drawings of public improvements. This scale was chosen after considerable deliberation and altho it is larger than necessary for some purposes, it has proven a very effective scale for other purposes and quite convenient for general use. It is our rule and practice to have a continuous profile thruout the block and establish a grade thereon before setting stakes for even a short improvement in any block.

Two vertical files are maintained in the office, one the usual correspondence file and the other the so-called "job file." When any work is ordered or started, a folder in this job file is made for it and in this folder are placed all papers, computation sheets, inspectors' daily reports, orders for extra work, or changes in plans, together with the engineers' copy of the specifications and contract covering the work. There is also a cross-index card referring to any correspondence pertaining to this particular job which may be found in the correspondence file. The entire history and departmental record of any one job is thus readily accessible.

We have attempted to simplify our cost account system as much as possible because our help for work of this nature is not sufficient to allow anything elaborate. The time of each man in the department, including the engineer, is kept on time sheets, which allow proper distribution of such time, and the cost of same is posted from these time sheets to the proper account cards. All bills are received in duplicate and from the copy kept in this office the costs of material and supplies are also posted to this same cost-account system. Material and supplies taken from the city storage yards are charged and carried thru as bills for material. We have found that this system kept up to date gives us at all times an accurate record of the cost of any part of the work of any particular job.

Following are some of the forms used, giving the size of card or sheet and the wording, without reference to manner of spacing on card.

MONUMENT

Character .....
Depth .....Condition .....
Witnesses: .....
Remarks: .....
Date .....Signed .....
.....
.....
.....
Card 3 by 5 in.

BENCH MARK

Location: .....
.....
.....
Description: .....
.....
.....
Elevation: .....U. S. G. S. datum .....
.....
Date .....Signed .....
Card 3 by 5 in.

HOUSE NUMBER

(Between) .....Block .....
Name of Owner .....
Addition or Subdivision .....
Lot No. .....
to house from .....line of .....
House No. given .....
Remarks .....
.....
Date .....Signed .....
.....
Card 3 by 5 in.

COST ACCOUNT CARD

Headings of columns:
Date Bill.
Date of Council.
Name.
For.
Amount.
Card 5 by 8 in.

ORDER TO DO WORK

Job No. .....
Ann Arbor, Mich. .....191....
To .....$.....
.....
Dear Sir:
You will please do the following work and report in the space provided below when same is completed.
.....
.....
.....
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.....
.....
.....
.....
.....*City Engineer.*
Attached:.....
The above work was commenced on.....191....
The above work was completed on.....191....
Remarks: .....
.....
.....
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.....
.....
.....
(Under remarks give any special or unusual features of the work and any cause for delay)
Signed .....
Size of sheet about 11 by 8¼ in.

ORDER FOR EXTRA OR SPECIAL WORK

Ann Arbor, Mich., 191....
To.....
Sirs:
You will please perform the following extra or special work, for which no price has been set in the proposal, in connection with the building of .....
.....
work which you are performing in and for the City of Ann Arbor, Mich. .....
.....
.....
.....
.....
.....
.....
For this extra or special work it is hereby agreed that you shall receive .....
.....
.....
Very truly,
.....*City Engineer.*
The above extra or special work and price for same is hereby accepted.
.....*Contractors.*
By.....
Original sheet on white paper to contractor; signed duplicate in pink to City Engineer; size about 8¼ by 11 in., left half occupied by above order and right half ruled in ⅛-in. faint blue squares.

CHANGE OF PLANS OR SPECIFICATIONS

Job No. .....
Ann Arbor, Mich., ...191....
To .....
Sirs:

You will please conform to the following changes in the plan / profile / specifications *for the building of* ....*work which you are doing for the City of Ann Arbor, Mich.*

.....
.....
.....
.....
.....
.....

For this work you will receive no extra or special compensation, same being fully covered in the specifications and proposal.

Very truly,

.....
City Engineer.

Received and accepted:

.....
Contractors

By.....

Original sheet on white paper to contractor; signed duplicate in blue to City Engineer, size about 11 by 8½ in. Bottom 3 inches of sheet ruled in faint blue ⅛-in. squares for making sketches or profiles.

INSTRUCTIONS FOR SEWER EXCAVATION

Job No.....
Depth Sheet for.....Sewer
Date.....
Note Book.....Page....

Headings of columns:
Station.
Depth in Feet and Hundreths.
Height of Bar Above Pin.
Remarks.
Size of sheet about 11 by 8½ in.

DAILY REPORT OF GENERAL OR SPECIAL WORK

Job No. .....
Date .....191....
Description of work:.....
.....
Location of work .....
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.....
Progress of work:.....
.....
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.....
.....
Contractor:.....
Labor:.....*man days at*..... .....*man hours at*.....
..... " " " .... " " " .....
..... " " " .... " " " .....
..... " " " .... " " " .....
..... " " " .... " " " .....
..... " " " .... " " " .....
Material: .....
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.....
Streets opened or closed:.....
.....
Remarks: .....
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.....
.....

Under remarks give time and causes for all delays and of extra or unnecesary work.

(*Signed*) .....
Title.....

Size of sheet about 11 by 8½ in.

LOS ANGELES POWER DEVELOPMENT

UTILIZATION OF SURPLUS POWER FROM THE LOS ANGELES AQUEDUCT

California is prompt in adopting new methods and apparatus which are of value and has taken up the motor truck in particular. Some idea of the various ways in which automobiles are used and of the provisions made for taking care of them will be gained from this article.

ALL obstacles have been removed from the path of municipal ownership by bringing to a final conclusion the long-drawn out negotiations between the city of Los Angeles and the Southern California Edison Company, which now includes the Pacific Light and Power Corporation, by a contract for the purchase by the city of the private distributing system which has finally rounded into shape.

This agreement was finally conceded by the power corporations, who have been holding out against distributing the city's power, or paying the city for any power distributed, until the purchase price, $8,270,000, had been paid for the plants by the city.

The companies now agree to distribute the city's power from the San Francisco power house No. 1, and will surrender full title to the distributing systems upon the payment of the purchase price by the city. This power house is capable of developing 37,000 horsepower at Los Angeles. Part of this power is now being distributed by the city in some of the outlying districts thru the distributing system built by the city. It is estimated that the city will have about 25,000 horsepower to dispose of, and the distributing of this by the two companies will bring an income of $100,000 a month to the city.

It will take some time undoubtedly to get the bonds voted and the money therefrom ready in hand to pay for the systems, but during this time the companies will be distributing the electrical energy generated at the municipal plant and not distributed by the municipal system, paying as previously stated $100,000 a month for the city's power. They are also to provide any extra electrical energy that the city may need or that may be needed to supply the demands of the city consumers.

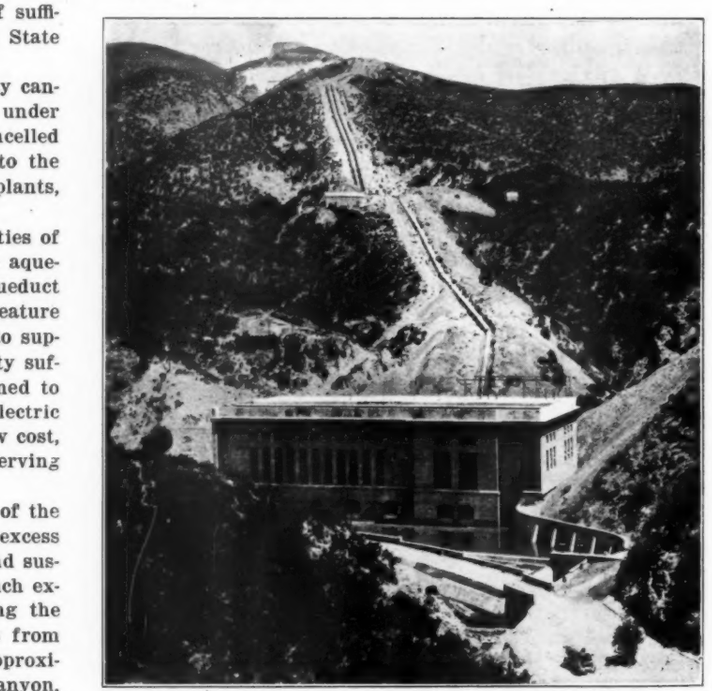
This contract between the city and the two companies is for a period of three months, from May 1 to August 1 of this year. The city has the privilege of extending this contract until July 1, 1919, provided that at least ten days before the expiration of the three-month contract written notices of such desire from the public service commission, approved by the city council, shall be given to the companies.

The city is to pay the companies a rate of 8 per cent., per annum on the purchase valuation of the companies' distributing system, $8,270,000. The companies are to retain from their collections the cost of maintenance of the distributing systems, and the proper proportion of the 8 per cent. annual payment, and are to turn into the city treasury daily the balance on their collections from the sale of city power. Exact settlements are to be made with the city treasurer on the 10th day of each month.

There is to be no paralleling of any portion of the distributing systems of the two companies during the life of this contract.

A board of supervisors is appointed, composed of two members from the city and two from the companies, to supervise the maintenance, extension and conduct of the business per-

ABOVE: GARVANZA DISTRIBUTING STATION AT 61ST AND MONTE VISTA, THE FIRST ONE BUILT.
BELOW: CONDUIT INSTALLATION IN LOW-TENSION GALLERY OF CENTRAL RECEIVING SUB-STATION NO. 1.



SAN FRANCISQUITO POWER HOUSE NO. 1, SHOWING ALSO THE PENSTOCK LINE AND THE SURGE TANK. THREE OF THE SIX UNITS HAVE BEEN INSTALLED AND FURNISH 37,500 HORSE POWER, PEAK LOAD.

formed under the contract. In case disagreement arises then a fifth member may be selected, or, if the matter is of sufficient importance, it may be placed directly before the State Railroad Commission.

In the event of extension of the contract the city may cancel the same at any time by giving three months' notice, under the same provisions as outlined above, or it may be cancelled by a majority vote of the people, or by the payment to the companies of the purchase price of their distributing plants, the city taking possession of the distributing systems.

The opportunity for the development of large quantities of hydro-electric power along the line of the Los Angeles aqueduct and on certain natural streams tributary to the aqueduct water supply has at all times been contemplated as a feature of the Los Angeles Aqueduct project which in addition to supplying the motive force for industry has a water capacity sufficient for the needs of 2,000,000 people. This is destined to be of immense value as a reliable source of hydro-electric power, which may be developed and supplied at very low cost, thus assuring low rates to electricity consumers and serving an important part in the encouragement of industry.

Opportunities for power development along the line of the aqueduct itself result from differences of elevation in excess of that which is required as a gradient for producing and sustaining a gravity flow of the water in the aqueduct. Such excess differences in elevation occur at four points along the duct; one just below the Haiwee reservoir, 162 miles from Los Angeles, where the difference of elevation equals approximately 190 feet; the second in the San Francisquito Canyon, 47 miles from the city, equaling approximately 940 feet. This is the plant that is now developing power for the city. The third point is in the San Francisquito Canyon, 40 miles from the city, equaling 530 feet, and the fourth between the end of the aqueduct and the lower San Fernando reservoir, 25 miles from Los Angeles, equaling 300 feet. This will give a total gross head of 1,960 feet available for power development with an assured constant flow of water of between 400 and 430 second-feet.

Altogether the power development thru these and other projects will be sufficient to deliver 200,000 h. p. to the city of Los Angeles.

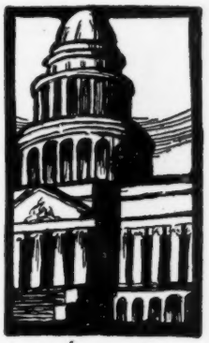
The power is transmitted over two separate steel-tower transmission lines of an unusually reliable design and fitting, supporting two electric circuits each, thus providing such duplication as to make complete interruption practically impossible, and affording a degree of reliability far in excess of the reliability of the average power system of the present day.

One of the drawbacks of large hydro-electric power plants is that they are usually at such a great distance from the point of use. The loss of power in such a case of long distance transmission is very great, but this is eliminated in this plant because of the nearness of the point of use, the two largest plants being approximately 47 miles from the point of use.

The reliability of water for the power plants is assured thru the acquisition of the Fairmont storage and regulating reservoir and the Dry Canyon reservoir above and below the power plants. This will assure development of capacities sufficient to take care of peak demands approximately two and a quarter times greater than the average.

These storage and regulating reservoirs together with the Haiwee reservoir, the Long Valley reservoir and proposed reservoirs on the Cottonwood and other creeks above the power plants will thus not only provide assurance against any emergency along the line of the aqueduct affecting the power supply and against the shortage of water during dry periods, but also make possible variation in the flow of the water during the day so as to take care of peak loads without the necessity of providing for the great cost of installing and maintaining auxillary steam plants either for emergency use or for carrying peak loads.

LEGAL DECISIONS



Decisions of the Higher Courts of Interest to Municipalities

Sufficiency of Guaranty—Payment for Repairs on Guaranteed Pavement—In the case of Steele v. City of Duluth, Minn., (161 N. W., 593) the supreme court states that altho the pavement was a failure, there was sufficient evidence that the repairs ordered became necessary from causes not due to defective material or workmanship to warrant the decision that they should be paid for at the rate stated in the contract, $2.50 a sq. yd.

Arbitration Clause in Contract—In the case of the City of San Antonio, Tex., v. Reed, et al., (192 S. W. 549) the Court of Civil Appeals states that where the city empowered the mayor to enter into a contract for street paving, the work to be controlled by the city engineer, it was beyond the mayor's powers to include in the contract an arbitration agreement, and the city was not bound thereby; the principle that those dealing with an agent are bound to ascertain the nature of his authority being more strictly applied in regard to municipal corporations than private corporations.

Payment for Reconstructed Street—In the case of Louisville, Ky., v. Tyler, some years ago, it was decided by the Kentucky Court of Appeals that abutting property could not be assessed with the cost of reconstructing a street altho the original construction had not been made by ordinance or at the cost of the abutting property owners, thus putting much expense on cities for reconstructing streets which had originally been constructed as roads before they were included within the city limits. This decision was disapproved by the same court later in the case of Catlettsburg, Ky., v. Self, in which it was held that a street is not orignally constructed in the sense intended by the law until it has been constructed at the cost of the adjoining property owners; also it was overruled specifically in the case of Louisville, Ky., v. Stoll. This decision is again confirmed in the case of Curran v. City of Ludlow, Ky., (192 S. W., 526) covering a case where three adjoining towns had improved a road thru them at common expense, which was then turned over to the three towns to take care of their own sections respectively. A subsequent reconstruction of the section in Ludlow at the expense of the abutting property owners is held to be legal and valid.

Payment for Improvement of Street Intersections—The Court of Appeals of Kentucky in the case of Tapp v. Johnson, Mayor of Henderson (192 S. W., 504) decides that the law governing third-class cities providing that a city may pay for improvement of street intersections or assess the cost on the abutting property means that when a city has decided upon one of the two methods it must continue to follow it until a change is made by an act of the legislature.

Two Water Pipes in a Street—An ordinance requiring two water mains in a wide street cannot be said to be so unreasonable as to constitute an abuse of discretion by the council or an arbitrary imposition of an unjust burden upon the owners of property.

Responsibility for Damage Caused by Projecting Manhole Cover—A manhole at the intersection of two very lightly traveled streets in Grinnell, Ia., projected 17 inches above the roadway surface and it was concealed by weeds and grass, and there was no light at the corner. An automobile backed into the projection in attempting to turn round and its transmission and crank case were badly damaged. If there were no contributory negligence the city would be liable for the damage altho the automobilist had not obeyed the law regarding registration of his vehicle. Wolford v. City of Grinnell (Iowa) 161 N. W. 686.

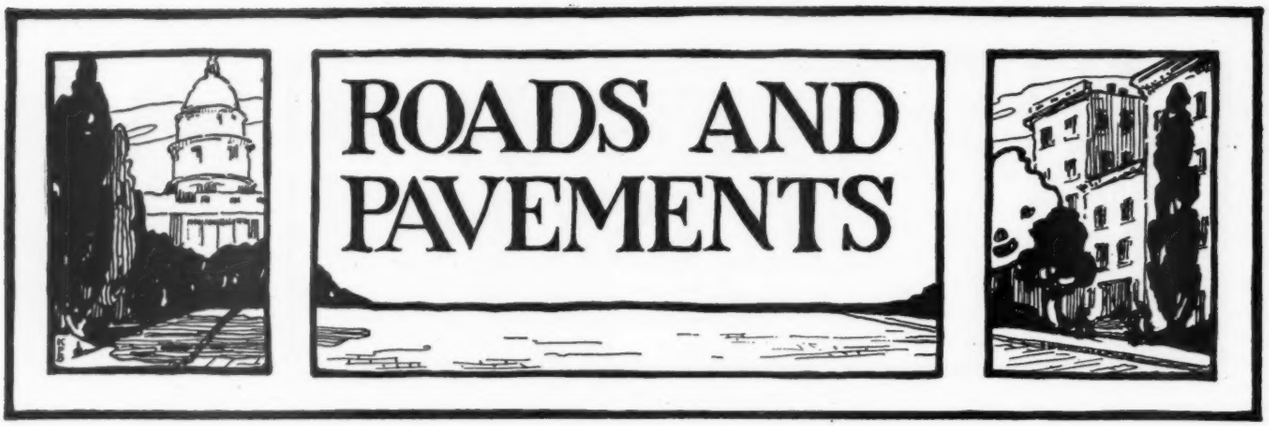
Damages for Change of Grade of Sidewalk—City officers ordered a sidewalk constructed on a new grade higher than the old one and the property owner so constructed the walk. He could not collect damages for the consequent raising of his house, because the proceeding was not under authority of a city ordinance and a city is not liable for the unauthorized acts of its officials and still less for consequential damages because of obedience to unauthorized orders of such city officials. Johnson v. City of Granville, N. D., 161 N. W., 721.

Separate Water Meters for Building Tenants—A municipal regulation that there should be but one connection and one meter to supply a building with water from the city's plant is held to be unreasonable and void as it makes a discrimination between lessors and lessees as to water service and separate meters and connections should be furnished the several tenants. City of Galveston (Tex.) et al., v. Kenner, 193 S. W., 208.

Construction of Municipal Sewage Disposal Plant Enjoined—In the case of the City of Marlin (Tex.) et al. v. Holloway et al., 192 S. W., 623, the supreme court sustains the lower court, in granting an injunction preventing the city constructing a sewage disposal plant near a residence district and inside the city limits because, among other reasons, "the evidence (shows) that offensive odors emanate from all types or systems of sewage disposal plants except possibly that known as the activated sludge system, which is not the kind designed for the City of Marlin, and which the evidence indicates would not be practicable for a city the size of Marlin."

Fees for Structures Under Streets—A city, in the regulation and supervision of a street, may require an abutting owner, though the owner of the fee, to obtain a permit and pay a fee for the privilege of constructing vaults under its surface. Appleton et al. v. City of New York, 114 N. E., 73.

Protecting Fence at Bridge—The duty of a municipality to maintain a railing or barrier upon its streets is not absolute and is not required unless the dangers are unusual. The street was reasonably safe for ordinary uses if the city maintained a board fence at the side of a bridge, even if an automobile, on account of defective steering gear, went thru it and a person was injured. Swain et al. v. City of Spokane (Wash.), 162 Pac., 991.



Hauling Gravel by Team and Tractor and Comparative Costs

By Orrin J. Kipp, before the Minnesota Surveyors' and Engineers' Society.

The data that I will present and the conclusions that I may suggest are derived from the gravel checkers' records on five team hauling jobs totaling 22 miles of road graveled and one tractor hauling job covering 3.6 miles of road graveled, the gravel being placed at the rate of 15 cu. yds. per 100-ft. station on each job.

Gravel hauling by team is familiar to all, and no description of outfit or method is necessary other than the statement that ordinary dump planks were used and 1½-cu. yds. per load were hauled uniformly. The team wagons were loaded by hand shoveling. The number of shovelers in addition to the teamsters shoveling varied from none for a portion of the time on job No. 1 to a maximum of two on all of the jobs.

The data obtained from the checkers, together with percentages and averages derived therefrom, I have compiled in the following table, in which are shown from each job and each haul length on each job, the following data:

GRAVEL HAULING COST DATA

Length of Haul	0-½ Mi			½-1 Mi			1-1½ Mi					1½-2 Mi				2.5M	2.5M	2.95M
Job No	1	2	5	1	2	5	1	2	3	4	5	1	3	4	5	3	3	1
Total No loads hauled	407	475	482	327	1571	364	606	525	898	44	746	312	873	434	198	337	267	714
Av No teams hauling	72	52	45	96	70	90	65	76	70	60	87	64	75	52	46	80	72	87
Av No loads per team day	12.1	14.0	9.45	9.75	11.67	7.35	7.0	9.1	7.55	7.33	6.0	5.4	6.93	6.73	5.35	4.6	4.0	3.9
Load Miles per team day	4.24	4.62	2.83	7.31	8.75	5.51	8.75	11.38	9.44	9.16	7.50	9.45	12.13	11.78	9.36	10.35	11.00	11.51
% Time dumping 5 Min per load	10.0	10.9	7.8	8.1	9.7	6.1	5.8	7.6	6.3	6.1	5.0	4.5	5.8	5.6	4.4	3.8	3.3	3.2
Av actual time in pit per load	30.6	25.0	46.0	26.6	16.5	44.7	30.7	11.0	24.4	24.5	45.0	36.0	11.5	14.2	37.2	36.0	35.1	30.9
% actual time in pit per load	61.7	58.3	73.3	43.2	32.0	57.2	35.9	16.7	30.7	32.9	45.0	37.5	13.3	15.9	33.2	27.2	23.4	20.1
% of time required for loading-12m per load	24.2	28.0	18.9	19.5	23.3	14.7	14.0	18.2	15.1	14.7	12.0	10.8	13.9	13.5	10.7	9.2	8.0	7.8
% of time actually lost in pit	37.5	30.3	54.6	23.7	8.7	42.5	21.9		15.6	18.2	33.0	21.7		2.4	22.5	18.0	15.4	12.3
Av No of teams at pit	4.5	3.0	3.3	4.1	2.2	5.1	2.3	1.3	2.2	2.0	3.9	2.0	1.0	0.8	1.5	2.2	1.7	3.8
Hauling cost per cu yd - in cents	21.9	19.0	28.3	27.3	22.9	36.3	38.1	29.4	35.3	36.6	44.4	49.4	38.4	40.0	50.0	58.0	66.7	67.0
Total cost per cu yd mi/s - loading & hauling	29.9	28.0	38.3	34.3	30.9	46.3	49.1	39.4	47.3	51.4	56.4	66.0	51.4	60.0	75.0	76.0	89.7	76.0
Contract price per cu yd - in cents	45.0	39.0	35.0	60.0	50.0	45.0	70.0	65.0	65.0	60.0	65.0	85.0	80.0	75.0	80.0	107.5	127.5	109.0
Spreading cost per cu yd - in cents	2.00	2.25	3.75	1.75	2.00	2.50	3.75	2.50	3.00	3.75	3.00	5.00	3.25	5.00	6.25	4.50	5.75	3.25
Hauling cost per cu yd mile-in cts-actual	7.30	5.76	9.43	3.64	3.05	4.84	3.05	2.35	2.82	2.91	3.55	2.82	2.20	2.28	2.85	2.58	2.43	2.77
with 12 min for loading	4.50	4.30	4.30	2.78	2.78	2.78	2.38	2.35	2.38	2.38	2.38	2.20	2.20	2.20	2.20	2.12	2.06	2.12
with 6 min for loading			3.41	2.45			2.17											
Hauling cost per cu yd-in cts - 12 min for Ldg		4.35			2.05		2.98						3.85					
with 6 min for loading																		

The above figures based on 25¢ per hour for man alone and 40¢ for man & team

From the above table we find that providing the time of loading were reduced to 12 minutes per load the hauling cost per cu. yd. mile would be as follows: 0 to ½ mile haul, 43 cents; ½ to 1 mile haul, 27.8 cents; 1 to 1½ mile, 23.8 cents; 1½ to 2 mile haul, 22 cents; 2 mile haul and over, 21.5 cents. If the loading time could be reduced to 6 minutes per load the hauling cost per cu. yd. mile would be further reduced as follows: 0 to ½ mile haul, 34.1 cents; ½ to 1 mile, 24.5 cents; 1 to 1½ mile, 21.7 cents, and above 21.5 cents per cu. yd. mile. Also, on a 12-minute loading basis the cost per yard for the hauls would be as follows: 0 to ½ mile, 13.5 cents; ½ to 1 mile, 20.5 cents; 1 to 1½ miles, 29.8 cents; 1½ to 2 miles, 38.5 cents.

The data in the foregoing table warrant these conclusions, for we find in Job No. 2 on the ½ to 1 mile haul the cost was 22.9 cents with an 8.7 per cent. loss of time at the pit; on the 1 to 1½ mile haul the cost was 29.4 cents as compared with 29.8 cents as estimated, while on the 1½ to 2 mile haul of Job No. 3 the cost was 38.4 as compared with the estimated cost of 38.5 cents and on a 2.95 mile haul the cost was 67 cents with a 12.3 per cent. loss of time as compared with the estimated cost of 65 cents.

It would thus appear that efficiency in team hauling and consequent low cost is largely dependent upon efficiency in loading. The total loading and hauling cost on the various jobs provides for the shovelers actually employed and $5.00 per day additional for the general superintendence of a foreman or the contractor. The resulting loading costs varying from 7 cents to 25 cents per yard, the lower figures being too low on account of the teamsters acting as shovelers while waiting to get into the pit and the highest figures being boosted on account of an excessive amount of frost and firewater, and poor supervision. The lowest job average was secured on Job. No. 2, it being 9 cents per yard. Favorable conditions were a large factor in producing this low figure. It would appear that for average Redwood County pits 10 to 15 cents per cu. yd. should cover the item of loading by hand. Whether or not some mechanical loader would be able to reduce this item I am unable to state.

The tractor hauling outfit used in Redwood County consisted of a 30-60 Holt caterpillar gas tractor and a train of seven Troy 3½-yd. reversible spread wagons, a 50-yd. storage bin and a belt conveyor loader.

Difficulties were encountered from the very start. Considerable time was consumed in erecting the storage bin and loader. When the first train was finally loaded ready to start it was found that the tractor would not pull more than two cars over a short sharp pitch at the railway crossing on the most direct route. After some investigating and experimenting it was found that four cars could be hauled across private fields to the top of a short pitch about ¾ of a mile from the pit and that by doubling back for the remaining three cars a train of five cars could be made up and hauled the remaining distance of 2¼ miles. Thirteen hundred sixty-five cu. yds. were hauled in this way over an average haul of 3 miles or a total of 4,125 cu. yd. miles, at the average rate of 129 cu. yd. miles per day, which on a basis of $20.00 per day to cover the cost of operation, interest and depreciation was at the rate of 15.4 cents per cu. yd. mile for the hauling.

From the next pit they hauled a total of 1,584 cu. yds. onto a stretch from 1 to 3.6 miles distant, making a total of 3,422 cu. yd. miles. There were no grades greater than 2 per cent. on this stretch and they made an average of 142 cu. yd. miles per day on this work, the cost being 14.1 cents per cu. yd. mile. Several days they were able to make as high as 216 cu. yd. miles, which would be at the rate of 9.2 cents per cu. yd. mile.

From the foregoing it would appear that the cost of haul-

ing by tractor was considerably less than by teams. The advantage in favor of the tractor would have been even greater, in my opinion, had there been more power available. A 40-80 tractor would have made a much better showing. Another factor cutting down the capacity of the train was the inability of the loading equipment to supply gravel fast enough. With ample power to pull six cars and a train load of gravel always ready when the train arrived at the pit there is no doubt that the record of 9.2 cents per cu. yd. mile made on a few days could have been maintained thruout the job. It is essential to have a bin full of gravel ready to dump into the cars quickly when the train arrives at the pit, for the outfit cannot make any money while waiting to be loaded. A bin of from 25 to 30 cu. yds. capacity must be provided. The bin must be easily transported from pit to pit, the loading apparatus also. A belt conveyor and a non-portable bin is not practical, for I've seen them tried and the cost of tearing down, moving and re-erecting the bin alone amounted to fully 10 cents per yard of gravel handled. The belt conveyor may be successful on a level grade or a very slight incline, but when it comes to raising the gravel about 30 feet vertically you have gone beyond the practical range of a belt conveyor. I have no definite data as to the cost of loading with this apparatus, but as nearly as I can estimate it was between 25 and 30 cents per yard, which, together with the cost of moving the bin, makes a total loading cost of 35 to 40 cents per yard.

It would seem that with the proper equipment the total loading cost should not exceed 10 cents per cubic yard. If this is possible the comparison between tractor and team hauling is very much in favor of the tractor.

Besides the cost there are other features in favor of tractor hauling which I wish to point out briefly. First: By applying the gravel in two courses with a tractor you get your gravel rolled without additional cost and the road is ready for travel as soon as the gravel is applied instead of a month or more later as with teams. Second: By loading into a bin, thence to the wagons and thence to the road you obtain an efficient mix of the materials so that instead of having one load with good gravel with a fair amount of binder followed by a load of sand with no binder and the resulting hard bump and chuck hole a few weeks later, you have a gravel of uniform consistency which does not tend to develop waves or chuck holes.

Proposed Wagon Road Tunnel Under Hudson River from Jersey City to New York

The Public Service Corporation of New Jersey, operating city and interurban electric railways in Jersey City, Newark and other places, has been considering plans for extending its interests across the Hudson river to New York city by means of a tunnel; and, according to Thomas N. McCarter, president of the corporation, in a statement made before the Newark Board of Trade, such a project has elements of reasonableness. The thing contemplated is a tunnel for motor trucks.

Mr. McCarter estimates that a tunnel, from near Twelfth street in Jersey City to Canal street, Manhattan, could be built for about $10,000,000. Such a tunnel would be about two miles long, and about one mile of it would be beneath the river. The ruling grades would be less than three per cent. The statement says that last year the ferries between Manhattan and New Jersey points carried 6,130,945 vehicles, of which about one-half were on the ferries of the Pennsylvania, the Erie and the Lackawanna railroads. The average fare paid by these vehicles on the boats was 27¾ cents each. It is estimated that by 1920 the railroad ferries referred to will be called upon to carry about 4,000,000 vehicles yearly; and as a tunnel would save for them considerable time, it is calculated that a charge of 35 cents a trip could be made. It is estimated that by 1920 not less than 60 per cent. of the freight wagons in use in this territory will be motor driven.

Mr. McCarter's statement is based on the results of studies made by William H. Burr, Ralph Modjeski and Daniel E. Moran. They calculated that motor vehicles would run at ten miles an hour and go thru the tunnel in about eleven minutes, and it is estimated that 2,000,000 of them would use the tunnel the first year. At this rate, and calculating the hourly fluctuations according to the actual present traffic over the five principal ferries, the average distance between vehicles following one another thru the tunnel would be in the busiest hour of the day (8 to 9 a. m.), 189 feet.

The officers of the Public Service Corporation hope that a tunnel will be built by the states or counties, or at least with public money; but if that should not come to pass they might, at some later date, consider construction by the Public Service Corporation.

Good Roads Notes

The North Platte Valley Highway Association has been formed to promote a connecting highway thru the North Platte Valley from North Platte, Neb., on the Lincoln Highway to the Yellowstone Park Road. H. A. Mark, secretary of the Community Club of Oshkosh, Neb., is the secretary of the association.

Connecticut is finding that the construction of its original good roads of waterbound macadam was not economical and is resulting in bills for maintenance which have been increasing each year, the road surfaces not being sufficient for the traffic over them. Recently the state adopted the policy of renewing the roads most heavily traveled with harder surfaces and, as a result, has reduced the rate of increase of maintenance charges and in some districts has actually reduced the annual cost of maintenance. Bad frost conditions and heavy trucking traffic are responsible for the damage and light foundations come in for some responsibilty on the thru routes of heavy vehicles.

Expenditures for good roads in the Southern States were 2½ times as much in 1914 as they were in 1904, showing a real awakening to the necessities of the case. Nine per cent. of the roads now have modern surfaces, as against 6 per cent. in 1909. In Kentucky over 21 per cent. of the roads were surfaced by 1914, and at the other end was Oklahoma with only 0.11 of 1 per cent. That these roads are not up to modern standards is shown by the statement that of the 73,600 miles of surfaced roads about 40 per cent. are sand-clay, 29 per cent. macadam, 24 per cent. gravel and only about 7 per cent. of the harder surfacing such as bituminous macadam, brick, concrete, etc.

One of the first bridges designed by a certain state highway department was at a small railway station miles from the county seat, where, to the people and the commissioners, the requirement that the structure should be able to carry a load of 6 tons seemed excessive. Scarcely a year later road bonds were issued by the county in which this bridge is located, and the bridge had to be strengthened to carry a 12-ton road roller. The more general use of traction engines and motor trucks tends to put all roads in the "important" class, so far as their bridges are concerned. Agricultural tractors with shipping weights of 17½ tons, motor trucks carrying loads of 10 tons in addition to their own weight, and trailers carrying loads of 15 tons are in use. In order that such loads can be carried safely and bridges may be strong and durable enough to have ultimate economy, all structures with roadways of 18 feet width or less, except those near cities, should be designed to carry a load of 15 tons on two axles 10 feet apart, the rear axle carrying 10 tons and the front axle 5 tons. Near cities it is better to design structures for a 20-ton load.

Bituminous Macadam Pavements Laid in 1916 and Proposed for 1917

Descriptions of Pavements as laid, cost per square yard and total cost.

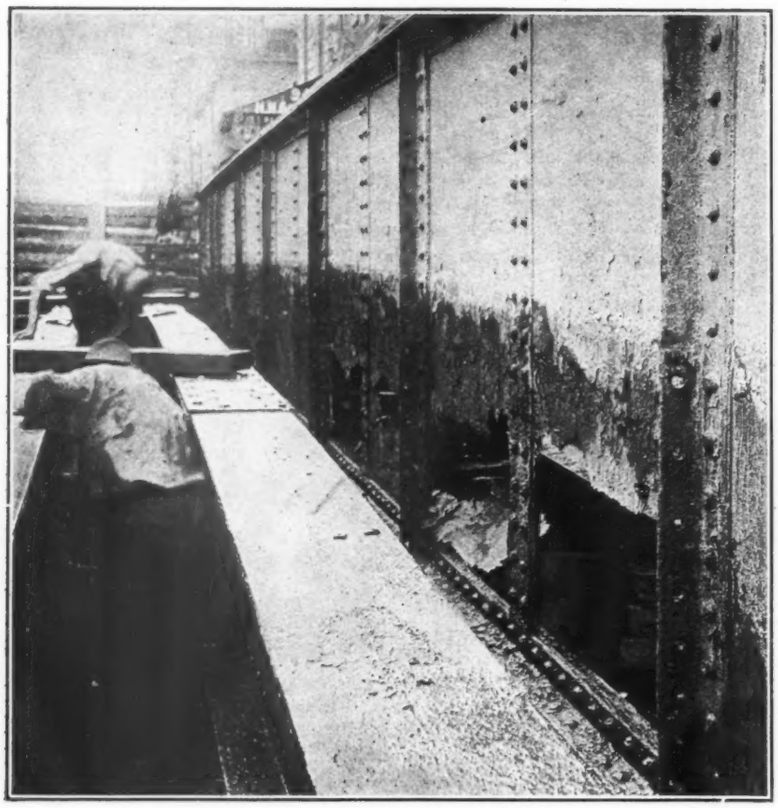
Design, Cost and Quantity are shown.

State and City	Sq. yds. laid 1916	Base: Thick	Base: Kind and Propor.	Top: Thick	Top: Kind and Amt.	Cost per sq. yd. pave. and foundation	Total cost of pave., inc. (1) (2) (3) (4)	Kind of Bitumen	Proposed yardage in 1917
Arizona—									
Phoenix	32,089	...	.....	.....	....	1.24	63,850	.....	.....
California—									
Alhambra	3,480	...	.....	.....	....	.....	.....	.....	.....
Glendale	37,600	...	.....	5	....	0.72	.....	.....	.....
Long Beach	5,094	...	.....	5½	....	1.42	.....	.....	.....
Los Angeles	20,098	...	.....	.....	....	0.90	18,088	.....	.....
Pasadena	32,423	...	.....	1-6	....	0.517	24,039	.....	.....
Pomona	1,872	...	.....	.....	....	0.08¼	1,668	California	.....
Redondo Beach	64,500	...	.....	2½	....	0.40	.....	.....	.....
Richmond	64,071	6[37]	.....	1½	....[40]	0.72	.....	.....	5,000
Santa Ana	85,598	2	.....	.....	....	0.36	.....	92% Asph.	.....
Santa Monica	42,415	2	.....[39]	.....	....	0.24	11,768	.....	.....
Sausalito	8,000	...	.....	2	....	1.03	.....	.....	.....
Vallejo	2,000	...	.....	¾	1 gal.[1]	0.45	.....	Oil	.....
Connecticut—									
Ansonia	4,850	5	.....	.....	2½	1.36(1)	.....	Bermudez	.....
Danbury	8,000	4	.....	2	....	0.90-1.10	.....	Tarvia-Berm.	.....
Enfield	10,500	...	.....	2¼ gal. sq. yd.	....	1.37-1.77	.....	Tarvia X	.....
New Haven	18,824	4	.....	2	2 1-3 g.[1]	1.02	1.13	.....	14,000
New London	4,820	...	.....	.....	....	0.61	2,937	Tar	6,500
Putnam	6,000	4	.....	2	....	0.80	5,000	Mex.-S. O. B.	1,000
Wallingford	6,500	7½	.....	.....	....	1.30	.....	.....	3,500
Florida—									
Tampa	18,203	4	.....	2	....	1.22	.....	.....	.....
Georgia—									
Atlanta	63,433	...	.....	.....	....	.....	63,433	.....	.....
Brunswick	7,500	...	.....	.....	....	.....	.....	Tarvia	.....
Illinois—									
Ardmore	.....	...	.....	.....	....	.....	.....	.....	20,600
Chicago	480,000	...	.....	.....	....	1.33	2.447	.....	.....
Cicero	.....	...	.....	.....	....	.....	.....	.....	31,920
Evanston	21,166	5	1:3:6	3¼	....[117]	1.28	34.668	Bermudez	36,676
Evanston	3,970	...[41]	.....	3¼	....[117]	0.79	3,288	Bermudez	.....[9]
Hinsdale	5,952	...	.....	2	....	1.19	11,343	Tarvia	5,600
Joliet	37,900	...	.....	.....	....	1.50	76,935	.....	.....
LaGrange Park	32,000	...	.....	3	....	.355	12,280	Tarvia	.....
Lake Forest	22,500	...	.....	2	....	.465	.....	.....	.....
Lyons	.....	...	.....	.....	....	.....	.....	.....	5,000
Marion	28,733	...	.....	6-9	....	1.48	.....	.....	.....
Peoria	6,044	...	.....	2	....	1.18	8,969	.....	31,500
Wheaton	13,344	...	.....	.....	....	1.73	(1) (2) (3)	.....	.....
Indiana—									
Crawfordsville	4,116	...	.....	.....	....	.....	.....	.....	.....
Crown Point	13,000	...	.....	.....	....	0.85	.....	.....	.....
Ft. Wayne	27,218	...	.....	.....	2½ gal.[1]	0.95	35,581	Standard C	.....
Gary	6,500	...	.....	3	....	0.90	.....	.....	.....
Marion	208	...	.....	.....	....	0.88	.....	.....	.....
South Bend	7,054	...	.....	.....	....	1.045	12,847	.....	.....
Iowa—									
Keokuk	.....	...	.....	.....	....	.....	.....	.....	4,128
Kansas—									
Leavenworth	.....	...	.....	.....	....	.....	.....	.....	45,000
Pittsburg	34,826	4	1:2:5	2[20]	18%[12]	1.35	66,367	Stanolind	.....
Rosedale	.....	...	.....	.....	....	.....	.....	.....	2,000
Wichita	.....	...	.....	.....	....	.....	.....	.....	15,000
Kentucky—									
Louisville	5,962	...[41]	.....	2	....	1.10	.....	Tar	0
Middlesboro	20,540	...	.....	6	....	0.85	.....	.....	.....
Maine—									
Bangor	18,296	...	.....	6	....	1.23	.....	.....	.....
Portland	3,034	2 gal. per sq. yd.		.....	....	1.398	4,243	Texaco 130	.....
S. Portland	10,935	8	macadam	.....	3 gal.	0.78	8,514	Tarvia	.....
Maryland—									
Frederick	4,095	...	.....	.....	....	.....	3,800	.....	11,370
Westminster	8,533	...	.....	10	....	4.00	.....	.....	.....
Massachusetts—									
Arlington	14,160	...	.....	.....	....	.....	.....	.....	.....
Boston	119,198	...	.....	6	....	0.93-1.00	.....	.....	.....
Brookline	38,600	...	.....	.....	....	0.55	21,132	.....	40,000
Cambridge	59,050	...	.....	.....	....	.....	.....	.....	.....
Concord	19,190	...	.....	.....	....	1.70	.....	.....	.....
Fitchburg	19,265	6	.....	2 gal.[1]	....	1.20	23,118	Bermudez	.....
Greenfield	2,800	...	.....	.....	....	.....	.....	.....	5,000
Haverhill	46,850	4	.....	2	....	1.20	.....	Indian	45,000
Lawrence	2,430	...	.....	.....	....	.....	.....	.....	.....
Leominster	8,500	...	.....	7	....	1.41	.....	.....	.....

State and City	Sq. yds. laid 1916	Base: Thick	Base: Kind and Propor.	Top: Thick	Top: Kind and Amt.	Cost per sq. yd. pave. and foundation	Total cost of pave., inc. (1) (2) (3) (4)	Kind of Bitumen	Proposed yardage in 1917
Lowell	35,384	...	.....	4	....	1.25	.....	.....	.....
Lynn	10,566	4	.....	½	....	0.63	.....	.....	10,000
Medford	24,817	...	.....	4-6	....	1.00-1.25	.....	.....	.....
Methuen	10,560	...	.....	.....	....	0.50	.....	Tarvia X	.....
Middleboro	15,840	...	.....	.....	....	.....	18,000	.....	12,000
New Bedford	76,768	6	.....	2	....	.....	.....	Tarvia	.....
Newton	60,000	...	.....	2½	....	0.65	.....	Tarv. Tarite	.....
N. Adams	.....	...	.....	.....	....	.....	.....	.....	8,000
Norwood	21,000	...	.....	6	....	.....	17,050	.....	.....
Peabody	3,899	...	.....	2	....	1.02	.....	.....	.....
Quincy	25,000	...	.....	.....	....	1.00	.....	.....	.....
Revere	15,681	...	.....	2-3	....	.....	1.05	Tarv. X-Berm.	20,000
Saugus	4,000	...	.....	4	....	0.50	0.50	Tarvia X	5,000
Southbridge	8,000	...	.....	4	....	.....	8,000	Tarvia X	10,000
Wakefield	5,000	4	.....	2	2 gal.	.....	1.25	Tarvia	10,000
Walpole	7,755	...	.....	.....	....	.....	.....	.....	.....
Waltham	14,950	...	.....	5	....	.....	1.16	.....	.....
Watertown	18,000	...	.....	.....	....	.....	24,000	.....	18,000
Webster	400	8	.....	.....	....	.....	0.62	.....	.....
Westfield	4,232	...	.....	.....	....	.....	0.49	.....	.....
Weymouth	1,948	...	.....	.....	....	.....	2,077	.....	5,000
Worcester	26,026	...	.....	.....	....	.....	0.91	.....	.....
Michigan—									
Adrian	4,950	...	.....	7½	....	1.23	.....	.....	.....
Benton Harbor	.....	...	.....	.....	....	.....	.....	.....	15,000
Holland	9,500	...	.....	2	....	1.20	20,415	Bermudez	14,000
Marquette	5,110	3	1½ gal.[1]	½	½ gal.[1]	0.912	.....	Bermudez	.....
Muskegon	15,706	...	.....	.....	....	0.43	.....	.....	.....
Negaunee	13,900	...	.....	.....	....	0.91	14,996	Stanolind C	13,000
Minnesota—									
Duluth	73,839	...	.....	.....	....	.....	.....	.....	.....
Rochester	24,753	5	1:3:5	2½	....	1.52	29,221(1)(3)(4)	Tarvia	.....
Missouri—									
Carthage	.....	...	.....	.....	....	.....	.....	.....	25,000
Columbia	19,717	6	.....[111]	2½	1.7-½[1]	0.83	26,913	Tarvia X	.....
Fulton	3,188	...	.....	2½	2 gal.[1]	1.19	(1)	Tarvia X	.....
Jefferson City	12,000	...	.....	2	3 gal.[1]	0.90	26,000	Stanolind	0
St. Louis	40,600	6[52]	3	.....	....	1.35-1.50	58,220	.....	25,000
Springfield	53,153	4-6	.....	2	2 gal.[1]	0.83-1.10	0.96-1.28	Tex.-Tarv. X	10,000
Nebraska—									
Norfolk	29,576	...	.....	.....	....	.....	.....	.....	.....
New Hampshire—									
Franklin	4,817	...	.....	.....	....	0.80	.....	.....	.....
Laconia	15,914	...	.....	6	2½ gal.[1]	0.86-1.40	24,441	Tarvia X	10,000
Nashua	25,000	...	.....	4	....	0.80	.....	.....	.....
New Jersey—									
Bloomfield	9,511	...	.....	.....	....	1.37	.....	.....	20,000
Montclair	7,500	5	1:3:6	2½	....[80]	1.42	14,900	Bermudez	10,000
Passaic	4,228	7	.....	.....	....	0.92	1.18	.....	13,600
Rutherford	9,000	6	.....	.....	....	1.15	.....	.....	.....
Summit	2,660	...	.....	2	....	0.63	.....	.....	3,000
W. Orange	.....	...	.....	.....	....	.....	.....	.....	10,000
New York—									
Amsterdam	5,860	...	.....	3	....	3,500	.....	Tarvia X	.....
Auburn	7,000	...	.....	.....	....	1.20	.....	.....	7,000
Bronxville	17,500	11	.....	.....	....	0.70-1.00	.....	.....	.....
Dolgeville	6,500	...	.....	3	....	1.32	.....	.....	.....
Elmira	.....	...	.....	.....	....	.....	.....	.....	12,000
Fulton	5,300	...	.....	.....	....	1.05	8,420	Bit. A.	9,300
Geneva	12,500	...	.....	3	....	0.90	.....	Montezuma	.....
Hudson	30,000	...[41]	.....	3	....	0.90	1.30	Standard	.....
Johnstown	300	5	.....	3	....	1.40(1)	.....	Bermudez	.....
Kingston	42,062	...	.....	6	....	.....	35.332	Trinidad	.....
Little Falls	2,962	3	.....	3	2 1-3 gal.[1]	1.30	2.00	Tarvia X	.....
Middletown	15,333	7	.....	.....	....	0.85	.....	.....	.....
New Rochelle	55,532	4[55]	1:3:5	2½	....	1.485[81]	30,613	Tarvia X	.....
New York—									
Queens	45,600	...	.....	.....	....	.....	.....	.....	.....
Richmond	14,261	6½	.....	.....	....	0.84	.....	.....	.....
Norwich	3,360	5-9	.....	6	....	1.93	8,514	Bermudez	.....[9]
Ogdensburg	6,021	...	.....	.....	....	0.60	.....	.....	.....
Oswego	1,425	5	1:3:6	3	....	1.65	2,778	Barber	0
Poughkeepsie	1,269	6	.....	3	....	0.79	1,000	Aztec	.....
Syracuse	37,325	...	.....	.....	....	.....	.....	.....	.....
Tuckahoe	24,000	7½	.....	.....	....	1.00	.....	.....	.....
North Carolina—									
Durham	2,000	...	.....	6	....	1.00	3,800	.....	.....
Greensboro	10,000	...	.....	.....	....	.....	.....	Oil Asph.	.....
Wilmington	1,400	8	2 gal.[1]	2	....[86]	1.25	.....	S. O.	.....
Ohio—									
Bowling Green	6,548	...	.....	.....	....	0.85-0.95	9,852	Bermudez	2,500
Cincinnati	6,593	6	.....	3	2 gal.[1]	1.16	22,092	.....	.....
Cleveland	2,500	...	.....	.....	....	1.20	.....	.....	.....
Columbus	3,785	...	.....	.....	....	0.92	.....	.....	.....
Mansfield	1,821	...	.....	.....	....	1.80	.....	.....	.....
Middletown	5,302	...	.....	2½	....	1.36	.....	.....	.....
New Boston	24,594	...	.....	.....	....	.....	.....	.....	.....
Piqua	16,600	6	.....	2½	....	1.35	27,026	Bermudez	.....
Van Wert	7,064	8	.....	.....	2½ gal.[1]	1.15	.....	.....	.....
Oklahoma—									
Durant	15,730	4	.....	2	....	1.24	28,700	Natural Rock	32,000

June, 1917.

State and City	Sq. yds. laid 1916	Base: Thick	Base: Kind and Propor.	Top: Thick	Top: Kind and Amt.	Cost per sq. yd.	Total cost, inc. (1) (2) (3) (4)	Kind of Bitumen	Estimated constr. for 1917
Pennsylvania—									
Carbondale	6,000	6	.....	3	....	1.39	.....	Tarvia	.....
Chambersburg	2,100	...	.....	.....	....	.....	.....	.....	.....
Chester	50,000	...	.....	.....	....	2.15	.....	Fibertine	.....
Norristown	5,930	4½	.....	2½-3	....	0.60-0.78	.....	Tarvia	6,000
Northampton	2,240	...	.....	.....	....	.....	.....	Pioneer	1,200
Reading	260	...	.....	.....	....	1.25	.....	.....	.....
Waynesboro	7,292	...[41]	.....	3	....	0.40	.....	.....	.....
Waynesboro	1,170	6	.....	.....	....	0.85(1)	.....	.....	.....
Rhode Island—									
Providence	2,954	...	.....	2½	....	.....	1.50	.....	.....
Westerly	40,000	6	.....	.....	....	1.05	.....	.....	.....
Woonsocket	15,000	6	.....	.....	....	1.00	.....	.....	.....
South Carolina—									
Florence	.....	...	.....	.....	....	.....	.....	.....	21,000
Greenville	12,000	...	.....	.....	....	.....	.....	Tarvia	.....
Texas—									
Austin	37,000	...	.....	.....	....	.....	.....	Tarvia	.....
Clarksville	2,400	...	.....	.....	....	.....	.....	.....	.....
Corsicana	3,938	6	.....	.....	....	0.85	5,162	Oil	.....
Corpus Christi	4,000	5	.....	.....	....	0.75	.....	.....	.....
Denison	14,222	...[49]	.....	.....	....	0.60	.....	.....	.....
Ft. Worth	11,384	...	.....	.....	....	.....	1.25	Tex.-Mag.	.....
Houston	5,504	...	G	1	surf.	0.56	3,100	Tarvia	.....
San Antonio	8,275	...[41]	.....	2½	....	1.00	1.00	Mexican	60,000[9]
Vermont—									
Montpelier	4,170	...	.....	.....	....	.....	.....	S. O. A.	5,000
Virginia—									
Clifton Forge	3,000	5	.....	3	2 gal.[1]	0.80	1.00	Berm.-Aztec	5,000
Danville	1,160	...	.....	.....	....	0.885	.....	.....	.....
Staunton	2,500	6	.....	.....	....	0.51	.....	Tex.-Aztec	.....
Washington—									
Pullman	12,445	6½	.....	.....	....	0.95	.....	.....	.....
West Virginia—									
Bluefield	4,926	4	1:3:6	2½	2½ gal.[1]	1.44-1.53	10,531	Bermudez	.....
Wisconsin—									
Baraboo	7,500	10	.....	.....	....	.....	3,000	.....	0
Eau Claire	6,150	...	.....	.....	....	1.08	2,004[54]	Sarco	.....
Janesville	14,388	4-7	.....	2	....	1.05	.....	Bermudez	46,000
Jefferson	25,000	...	.....	.....	....	0.90	.....	.....	.....
Oshkosh	4,120	...	.....	.....	....	0.96	5,445	.....	.....
Racine	.....	...	.....	.....	....	.....	.....	.....	5,537
Two Rivers	6,600	8	.....	.....	....	1.075	.....	.....	.....
Waukesha	11,013	6	.....	2½	....	0.92	16,448	Stanolind C	.....
Wausau	6,214	...	.....	.....	....	0.73	6,580	Sarco & Tar	3,000



SHOWING CORROSION OF WROUGHT IRON GIRDERS IN WASHINGTON ST. BRIDGE OVER BOSTON AND ALBANY RAILROAD, BOSTON, MASSACHUSETTS.

Rochester's Sewage Disposal Plant in Operation

On March 29 the East Side trunk sewer of the Rochester, N. Y., sewerage system was connected with the newly completed intercepting sewer and sewage disposal plant, and on April 27 the West Side trunk sewer was connected, so that now practically all the sewage of the city has been removed from the Genesee river, the lower portion of which has heretofore acted as a settling basin for the city's sewage.

Some parts of the system have been completed for a year or two, and there remain a number of accessories to complete, but the plant is ready to perform the major part of its functions and is now in operation.

Consulting Engineer E. A. Fisher of the city gives the following brief history of the development of the system, the entire cost of which will approximate $2,500,000:

"The main sewage disposal plant has been gradually put in operation since the East Side trunk sewer was turned into the system on March 29 until today, when the West Side trunk sewer was turned in, completing the interception of all sewers now emptying into the river except the small Lake avenue outlet sewer near the northerly boundary of the city on the west side of the river.

History of New System.

"Thirty years ago, in 1887, the Common Council appointed a special committee to investigate and report upon an East Side belt line sewer. Emil Kuichling made the necessary surveys and submitted a report in April, 1889. This was the first investigation relative to any treatment of the sewage of which we have a record.

"Mr. Kuichling's report briefly outlined several methods of disposal in use at that time, and as sewage farming with cultivation, filtration thru land without cultivation, chemical precipitation and the discharge of crude sewage into the lake.

"No further steps were taken in this matter until 1904, when Mr. Kuichling was again called upon to investigate and report upon a method of sewage disposal for the entire city.

"In 1907 George H. Benzenberg, of Milwaukee, and Rudolph Hering, of New York City, were associated with Mr. Kuichling, and in February presented a report concurring in Mr. Kuichling's report of the same year. No immediate action was taken, due to the fact that the extensive improvements in the waterworks system had brought the city close to the constitutional limit of indebtedness.

"Further studies were made by Mr. Kuichling and a supplemental report was made in March, 1910. The original plan made by Mr. Kuichling provided for a city of 275,000 population. This plan was revised, and the present installation provides for a future population of about 450,000, including the Brighton system.

Intercepting Sewer Plan.

"The intercepting sewer begins at the intersection of Central avenue and North Water street, taking in at that point the Central avenue sewer and the North Water street sewer and its tributaries east of the Genesee river. From this point the intercepter passes under the Genesee river in a tunnel 8 feet in diameter. The sewage is confined in a semicircular invert channel 3 feet wide. On each side of this invert are bench walls 2.5 feet wide, on one of which is laid a 20-in. water main and on the other a 17-in. Holly main, connecting the water systems on both sides of the Genesee river.

"From Front street the intercepting sewer is still in tunnel, and follows Central avenue to Mill street, thence in Mill street to Brown street, thence across the R., W. & O. R. R. lines to a short distance north of the R., W. & O. R. R. bridge, intercepting on its way the Front street sewer, the Platt street sewer and the Spencer street sewer. At the last named point, north of the R., W. & O. R. R., there is constructed a detritus tank, in which all heavy material, such as gravel and small stones, will be deposited before the sewage enters the cast-iron mains extending from this detritus tank along the bank of the river, crossing under the river opposite the Flower City Brewery, and thence running along the foot of the bank to a point opposite Avenue B, on the east side of the river, where the pipe ends in a tunnel intercepting at this point the Avenue B sewer.

West Side Sewer Enters.

"At this point the West Side trunk sewer enters the intercepter after crossing the river in a double cast-iron pipe inverted siphon, with a grit chamber on top of the bank at the extension of Glenwood avenue similar to that described near the R., W. & O. R. R. on the main line.

"From the intersection of the Avenue B sewer the intercepting sewer is still in tunnel to a point about 300 feet south of Norton street. From this last named point the sewer is in open cut to the Ridge road. At Norton street the East Side trunk line sewer is intercepted.

"From the Ridge road to the disposal plant the sewer is called an outfall sewer. At a point near the city line a sanitary sewer from Clinton avenue, north of Norton street, is taken in, and from this point to the disposal plant, a distance of four miles, there are no sewers intercepted excepting the sanitary sewage from some of the residences along the East Side boulevard.

"At the different points of interception of the existing outlet sewers regulating devices have been installed which can be adjusted to take into the intercepting sewer the dry-weather flow and a certain proportion of the stormwater flow. The existing sewers beyond the point of interception become overflow sewers for the surplus stormwater.

"The regulating devices are controlled by means of a float which rises as the stormwater in the sewer increases and closes the inlet to the intercepting sewer, so as to prevent a greater quantity being taken into the intercepter than contemplated.

"The plant is located in Irondequoit, about midway be-

tween Summerville and Sea Breeze, and about one-half mile south of the lake shore. At this place the city has acquired about 310 acres of land, which is adjacent to and west of the Durand-Eastman Park.

"The first structure at the entrance to the plant is a Venturi meter, which makes a continuous record of the quantity of sewage reaching the plant. The sewage then passed thru coarse racks of 2-in. openings, and enters the detritus tanks or grit chambers, of which there are six. These grit chambers are about 90 feet long, 10 feet wide and 3 feet in depth, for the retention of grit. These tanks are designed to retain only the heavier solids of the sewage, such as sand and gravel.

"From these tanks the sewage passes thru fine screens which remove floating and other suspended matter that would interefere with the operation of the tanks. These screens are known as of the Riensch-Wurl type, and have been extensively used in Germany. There are two screens 12 feet in diameter having openings ⅜-in. by 2 inches, and also two screens having openings of 1/16-in. by 2 inches. These screens are automaticaly cléaned, and the screenings are deposited in a small car, taken out and dumped on low ground. They will either be covered with earth or used as a fertilizer.

From Screens to Imhoff Tanks.

"From the screens the sewage enters the main distributing channel to the Imhoff tanks thru channels controlled by automatic regulators similar to those used in the intercepting sewers. The tank units are ten in number and are 115 feet long and 37 feet wide, and of a total depth of about 40 feet.

"The design of the tank provides for the separation of the old sewage from the new, and are what are commonly known as double-story tanks. The upper compartment or flowing-thru channel, is separated from the lower or sludge compartment by inclined slabs at the bottom of which is a 6-in. opening or slot thru which the sedimented matter from the upper chamber passes into the lower. These slabs are arranged in such a way that the escaping gases from the decomposing sludge will not enter the fresh sewage, but will escape thru gas vents at the side of the tanks.

"The sludge is retained in the tanks for a period of six months, and is removed thru 8-in. pipes, the discharge of which is below the water surface in the tanks, the hydrostatic head being sufficient to force the sludge out of the pipe.

Sludge Not Offensive.

"The sludge is discharged onto drying beds. The area of the present bed is about one and three-quarters acres. From these beds the dry sludge is removed in small cars and dumped on low ground. This sludge is without appreciable odor and can be disposed of on any part of the ground without offense.

"After passing thru the tanks the sewage discharges into the outlet pipe into the lake. This pipe is 66 inches in diameter and discharges at a point about 7,000 feet from the shore in 50 feet of water. The effluent will be used to develop power more than sufficient to operate and light the plant.

"The system has been designed for a future population of 450,000. The intercepting sewer, detritus tanks and screen buildings have been constructed for this future population, but only one-half of the Imhoff tanks have been built at present. These ten tanks, operating in connection with the Riensch-Wurl screen installation, have a capacity sufficient to take care of more than the present population of the city."

Modern Methods of Refuse and Garbage Disposal

Recent developments in garbage and refuse disposal have demonstrated the soundness of the reasoning in articles heretofore published in MUNICIPAL ENGINEERING, and the statements in this article, derived from reports of recent court decisions and from a recent paper by G. R. Tuska, consulting engineer, New York, before the American Association for the Advancement of Science, present the latest advances in the two directions in which success has been greatest in the larger cities.

The recovery of the values in the refuse and garbage is the point of greatest interest in modern methods, developed mainly since the subject has been made one for consideration by engineers rather than by physicians, and the possibility has been demonstrated that collection and disposal can be made without nuisance and in a perfectly sanitary manner.

There are two ways in which these values are now recovered. One is by using the steam power developed and the clinker produced in destructor plants and the other is by removing the valuable grease from garbage and reducing the remainder to a form usable in the manufacture of fertilizer.

The difference between the two methods begins with the collection system.

In the former system the best results are attained when all refuse except incombustible metals and mineral substances and including ashes, is collected together. But one receptacle is required for this collection unless the amount produced in a building is greater than a single can of convenient size for handling will hold. The refuse is comparatively dry and requires less care to prevent nuisance in handling and in transportation.

In the latter system the garbage must be separately stored and collected, and in it should be included only the decomposable wastes and the materials which will add to the value of the products of the garbage reduction plant. Combustible refuse must be destroyed in an incinerating plant of some sort, utilizing the resulting heat in producing steam or otherwise if possible, and the incombustible refuse, including ashes, can be used as filling for low lands, if decomposable materials other than manure and like substances are carefully excluded. This requires a triple collection, one of which must be carefully made in tight cans or wagons to prevent nuisance from odors and dripping of liquids, and a second must be made so that the light ash dust will not be blown about the neighborhood in emptying cans or hauling wagons. Three receptacles are required instead of one, and the regulations regarding careful separation of the three kinds of refuse must be thoroly enforced.

It is evident, therefore, that in estimating the sanitary value and the economic value of the methods under discussion for a certain city the cost and sanitary possibilities of the collection system must be considered as carefully as those of the disposal system; and that collection and disposal must be considered together as equally important parts of the problem, inseparable because each system of disposal has its own most suitable system of collection and cannot be served with full satisfaction by any other.

The high-temperature system of refuse destruction has been under a cloud for some time in this country because of two suits based on claims of municipal officials that the plants built for their cities did not fulfill their guaranties. The first decisions in both these cases have been rendered in favor of the constructors of the plants, their practical compliance with the terms of the contracts having been demonstrated to the courts and the extraneous and irrelevant source of the objections being quite clearly demonstrated.

There are twelve installations of one general design now in successful use in North America, ranging in size from 60-ton units at Montgomery, Paterson and West New Brighton to four 25-ton units at Havana, Cuba, besides the plant at San Francisco, which is not yet in regular operation.

There are many smaller installations of incinerating plants operating with lower temperatures which are lower in first

cost and of various degrees of success, in disposing of garbage or mixed refuse as to odors and smoke nuisance with or without additional fuel, all of which are installed in the smaller cities or to serve restricted districts in the larger cities.

Garbage reduction plants have been operated in the past by private corporations until Cleveland and Columbus demonstrated the possibility of operating such plants under municipal ownership successfully as regards financial returns and with fair success as regards nuisances created. Plants in other cities are increasing in number and Mr. Tuska's paper describes in some detail the plans for a plant for the boro of Manhattan, New York City, which seems to have some points of advantage, at least in the matter of freedom from nuisance, over its predecessors in the field.

The following is abstracted from Mr. Tuska's paper:

In the methods of reduction for the handling of garbage great improvements have been made in the last few years. Formerly, where successful reduction processes were used, they were only of two types, one where the garbage was mechanically dried in hot-air furnaces and the grease then extracted by means of a chemical solvent and the material then redried so as to produce a commercial product; the second where the garbage was digested, pressed and mechanically dried, the grease being extracted partly by pressing and partly by degreasing with chemical solvents.

The main objections to these plants have arisen from the gases produced in the destruction of the garbage and from the gases discharged in the drying processes.

To obviate these objections a new reduction process has lately been evolved. The operation of this process is as follows:

The raw garbage is placed in a closed tank, which is sealed air-tight. This tank or reducer is constructed with jacketed walls and jacketed bottom. Into these jackets the steam which is used in the reduction of the garbage is delivered, the jackets being so designed that it is impossible under proper operation for the steam to enter the tank or come in contact with the garbage. In the interior of this tank there is an agitating device operated by power from the exterior. When the proper charge of garbage has been placed in the reducer and the covers are placed thereon the tanks are sealed and the solvent is pumped into the reducer and steam is admitted to the jacketed walls. The heat from the steam, which is transmitted to the garbage thru the walls of the reducer, causes the evaporation of the solvent and the water in the garbage.

Garbage is usually composed of over seventy-five per cent. by weight of water. The steam heat vaporizes the solvent and the water from the garbage and these mixed vapors are drawn off from the reducer to the condenser. The economy in this method of evaporation rests on the fact that water is vaporized at a lower temperature when evaporated with a solvent having a low boiling point than when evaporated without such a solvent.

The mixed vapors of the solvent and the water while in the condenser are there condensed to a liquid state and the water and solvent together are conveyed to a closed tank. Owing to the solvent being of lighter specific gravity than the water, the solvent and the water are separated by gravity, the solvent rising to the top, from where it is drawn back to the storage tanks and then pumped back to the reducers and used over and over. The condensed water, which has been largely diluted owing to the jet condensers used, is discharged into sewers or waterways.

When the garbage has been thoroly dried by this method the solvent is pumped into the reducer and dissolves the grease. The solvent with the grease is drawn off into a closed tank or evaporator, where the same is heated by steam pipes, where the steam is kept separated from the grease. The solvent therein is vaporized and carried to a condenser, where the same is again liquified and carried to the storage tanks to be used again.

After the grease has been extracted from the garbage in the reducer it is further dried by means of the steam in the jacketed walls and is now in the form of de-greased garbage tankage, which is used for fertilizer purposes after being ground and screened.

It will be seen that it is to the financial interest of the owner of the plant to see that there are no leaks or vents thru which the solvent can be lost. The garbage is at no time brought in contact with the atmosphere, from its original entrance into the reducer until after over twelve hours of cooking it is finally discharged, dried, sterile and practically odorless as grease and tankage.

The process is one of straight de-hydration. No process of digestion occurs and the odors and gases incidental to such a process are not created.

The water condensed contains all the gases evolved and has when fresh a slight odor of the mixed essential oils. Some traces of alcohol are detected in the effluent aand a very small quantity of fixed oils is carried over. Any ammonia evolved, if it has escaped the acid in the garbage is neutralized by acid carried over in the vapor. Whatever albuminoid ammonia exists in the effluent is carried over by mechanical entrainment as dust particles during the steaming out of the solvent.

The effluent from this process consists of almost pure water, this water being the condensed moisture drawn from the reducer while the garbage is being treated and from which the solvent has been extracted as completely as possible. The effluent is cold and gives forth no steam or vapor and is practically odorless, and as a result can have no undesirable effects when run into a large body of water.

The only other possible source of odor during the entire reducing operation would be in the air and gases mechanically included in the green garbage prior to its entrance into the reducer, so small that no objectionable condition can be created by their discharge.

The tankage when taken out from the reducer is in a dry condition and quite warm, and when it is first exposed to the atmospherer has momentarily a slight odor of dried material best described as a smell of stale gingerbread, due to the essential oils rising from the material when hot. No gases are generated and this odor lasts only during the period of emptying of the reducer, and is not offensive nor perceptible outside the building.

Heretofore gasoline has been used as the solvent in the degreasing process, but it has been proven that a more economical operation and an elimination of the danger of explosions is obtained by the use of a kerosene distillate obtained by the treatment of ordinary kerosene in a vacuum still.

The cost of a plant operating on the above system is from twenty to fifty per cent. greater than one on the digester system. The cost of operation per ton of garbage by this system is also considerably higher than by the digester system; the labor cost being about the same, but the cost for fuel and solvent being considerably greater.

As against this increased cost we have superior sanitary advantages and a considerably greater value of recovered products, more grease and a more valuable tankage, the potash contained in the vegetable fibre remaining in the tankage from this process amounting to over one per cent. by weight in the dried product.

The practical operation of this system has been demonstrated by the plants handling the garbage for the cities of Los Angeles, Cal., and New Bedford, Mass. The New York City plant now under construction will have a capacity of over two thousand tons of garbage per day and will therefore be the largest of its kind in the world.

MISCELLANEOUS

Meeting of Organizations

June 6-13, at Pittsburg, Pa. National Conference of Charities and Corrections. Wm. T. Cross, sec'y, 315 Plymouth Court, Chicago, Ill.

June 12-14, at Hotel Iroquois, Buffalo, N. Y. New York State Conference of Mayors and other City Officials. W. P. Capes, sec'y, 25 Washington Ave., Albany, N. Y.

June 20-22, at Buffalo, N. Y. American Institute of Chemical Engineers. J.C. Olsen, sec'y, Cooper Union, New York.

June 26-30, at Atlantic City, N. J. American Society for Testing Materials. Edgar Marburg, sec'y, University of Pennsylvania, Philadelphia, Pa.

September 24-29, at Santa Rosa, Cal. League of California Municipalities and Annual Public Welfare Exposition of municipal supplies, street and road-making machinery. F. J. Erb, director of exhibits, Pacific Bldg., San Francisco. H. A. Mason, sec'y, 1120 Crocker Bldg., San Francisco.

September 27 to 29, at Chicago Norske Klub, 2346 North Kedzie Boulevard, Logan Square, Chicago, Ill. Informal Congress and Reunion of American and Canadian Engineers and Architects of Norwegian Birth or Descent. Joachim G. Giaver, chairman of local Chicago committee on arrangements.

October 17-18, at St. Cloud, Minn. League of Minnesota Municipalities. Richard R. Price, sec'y, University of Minnesota, Minneapolis.

November 12-16, at New Orleans, La. American Society of Municipal Improvements. Chas. C. Brown, sec'y, 702 Wulsin Bldg., Indianapolis, Ind.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows: Electrical engineer, also metallurgist, in Springfield Armory, Ordnance Department at large, each at $3,000 a year, at any time application is made in due form. Also expert radio aid in Department of Steam Engineering, Navy Yard, Washington, D. C., at $6 a day.

Mechanical draftsman in Ordnance Department at large, at $1,320 a year.

June 5: Radio engineer at Ft. Huachuca, Ariz., and Ft. McIntosh, Tex., in Signal Service at Large, War Dept., at $1,800 a year.

June 6-7: Aid in Coast and Geodetic Survey, at $1,000 a year to begin.

June 12: Sub-inspector, aeronautical engines, in Department of Steam Engineering, Navy Yard, Washington, D. C., at $4.48 to $6.40 per day.

Technical Schools

A neat circular about the Engineering Schools of Purdue University, Lafayette, Ind., has been issued.

Municipal Reports

Report of Board of Water Commissioners of Westfield, Mass., for 1916, 24 pp. Henry W. Sanderson, Supt.

Report of Department of Public Works, Woburn, Mass., for 1916, 38 pp. H. V. Macksey, C. E., Supt. Pub. Works.

Report submitted to the Board of Estimate and Appointment by the chief engineer of the board on behalf of the Board of Consulting Engineers recommending the adoption of certain general rules governing the design of outlet sewers and sewer outlets, which report was approved and which rules were adopted by the Board of Estimate and Apportionment at a meeting held on Feb. 23, 1917. Paper, 11 pp. Nelson P. Lewis, chief engineer.

Reports of engineering department of Hartford, Conn., for 1914 and 1915. Paper, 41 and 45 pp. R. N. Clark, city engineer.

Report of the water board of Auburn, N. Y., for 1916. J. Walter Ackerman, chief engineer and superintendent.

Annual reports of the city of Prahran, Victoria, Australia, for 1915 and 1916. John Romanis, town clerk.

A Book on the Automobile

Dyke's Automobile Encyclopedia, fifth edition, is a practical automobile book from which one can learn about automobiles, trucks, also engines, etc. This book is the resultant of the first practical automobile book published in America. It contains 825 pages, 6¾x9¾ inches. There are 2,370 illustrations. In addition to the 50 instructions there is a supplement on the Ford and Packard, part of which is printed in two colors. There are 350 pages and 976 illustrations on electric subjects.

There are 74 pages and 254 illustrations on testing electric systems; 74 pages and 75 illustrations on the Delco system alone; 534 illustrations on repairing, and there are 4,000 lines to the index, which adds to its value as a ready reference.

In 1900 Mr. Dyke published "Dr. Dyke's Diseases of a Gasoline Automobile and How to Cure Them." This book was the first practical automobile book published in America. Although Mr. Dyke was engaged in the automobile supply business from 1898 to 1908, which by the way was the first automobile supply business in America, he did not lose sight of the fact that some day a good practical book would be in demand, therefore, he revised the book year after year. In 1908 he rewrote the book and changed the title to "Dyke's Automobile Encyclopedia."

Mr. Dyke's books are distinctively different from other books and evidently giving satisfaction as he claims that from a sale of 150,000 books not one has been returned. Mr. Dyke's books are not only used as a reference and guide to the thousands of automobile owners, but are in the hands of every practical automobile repairman in the country. They are used by many of the aviation posts and truck divisions of the

War Department, and fifty-six automobile schools, including a great number of the leading Y. M. C. A. schools from New York to San Francisco.

The publisher's address is A. L. Dyke, St. Louis, Mo.

Personal Notes

Rudolph Hering containues his practice as consulting engineer in New York City, since dissolution of his recent partnership.

E. B. Bradbury has been appointed sanitary engineer of Franklin county, at Columbus, O.

B. J. T. Jeup, city engineer, ex-officio, Jay A. Craven of the Terre Haute Water Company and C. H. Hurd of the Indianapolis Water Company, form the new Board of Sanitary Commissioners of Indianapolis, whose duties are to design and construct sewage and garbage and refuse disposal plants.

Gaylord C. Cummin has been appointed city manager of Grand Rapids, Mich., at a salary of $10,000 a year, having been promoted from a similar position at Jackson, Mich.

W. E. Baldry is the new city engineer of Topeka, Kan.

John H. Gregory, formerly of the firm of Hering & Gregory, continues his practice as consulting hydraulic engineer and sanitary expert at 170 Broadway, giving special attention to water supply and purification, sewerage and sewage disposal, garbage and refuse disposal.

Ralph W. Whitaker is city engineer of Bakersfield, Cal., in place of R. B. Ray.

F. S. Benson has been appointed city manager of Bakersfield, Cal.

Charles E. Hewes has left Alhambra to become city manager of Alameda, Cal.

Herbert Nunn is the new chief engineer of the Oregon State Highway Commission.

Daniel S. Miller has been promoted to city engineer of Long Beach, Cal.

A. T. Thompson is the new city engineer and superintendent of public works of Grand Rapids, Wis.

W. A. Powell has been promoted to city engineer of Rensselaer, N. Y.

W. D. Howren is the new city engineer of Amarillo, Tex., and A. D. Armstrong is city manager.

S. D. Newton is the new city engineer of Cleveland, Tenn.

Professor C. R. Richards, since 1911 at the head of the department of Mechanical Engineering of Illinois University, has been appointed Dean of the College of Engineering and Director of the Engineering Experiment Station of the University.

By a series of promotions W. J. Fulton becomes president of the board of public works of Gary, Ind., W. P. Cottingham, city engineer, and H. E. Jordan superintendent of parks.

J. L. Jacobs & Co., Monadnock Bldg., Chicago, engineers, cost accountants, and statisticians, announce an enlargement of their organization to furnish advice on revenue and expenditure, budgets, appraisals, civil service, salary and cost accounting standardization and allied services.

Mr. Guy Robert Ramsey, Assoc. M. Am. Soc. C. E., of Orlando, Florida, has joined the engineering staff of the Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio, and will be Division Engineer for the Southern States, with headquarters at Atlanta, Ga. He has had railroad, city engineering and highway experience and has a high standing among members of his profession. The Dunn Wire-Cut Brick Company now has eight engineers on its regular staff.

Charles H. Moore, president of the New Jersey Dock & Bridge Building Co., Elizabeth, N. J., died on May 1.

W. R. Caldwell is the new city engineer at Ypsilanti, Mich.

Frederick T. Elwood, city engineer, and former commissioner of public works of Rochester, N. Y., died on April 22.

Publications Received

Report of E. A. Stevens, New Jersey Commissioner of Public Roads, for 1916.

Report of Duluth, Minn., Water and Light Department for 1916. D. A. Reed, manager.

Military Preparedness and the Engineer, by Ernest F. Robinson, Assoc. M. Am. Soc. C. E., Captain Corps of Engineers, N. G., N. Y. Cloth, 224 pp., $1.50. Clark Book Co., 27 William street, Ne wYork City.

Dictionary of Altitudes in the Dominion of Canada, by James White, F. R. S. C., F. R. G. S., deputy head and assistant to chairman of the Commission of Conservation of Canada, Ottawa, Can.

The Industrial Arts Index, published by The H. W. Wilson Company, of White Plains, N. Y., is a cumulative index to engineering and trade periodicals. It is published in February, April, June, October and December. The list of periodicals makes the index well worth while and covers almost everything imaginable in the arts and sciences. There are large numbers of people to whom the Industrial Arts Index will prove a very valuable addition indeed to their book shelves of practical literature to be kept always at hand for reference purposes.

Public service rates in Texas cities have been compiled by Edward T. Paxton, secretary of the Bureau of Municipal Research and Reference of the University of Texas, at Austin, and published in Municipal Research Series No. 10. Water, sewer, light, gas, telephone and traction rates are given, with statement that there are none, or there is no report, so that every city is covered. Texas is the only state in which cities have the custom of charging or allowing charges for use of sewer systems. There are twenty-nine private companies and twenty-eight cities which charge rates for sewer service and twenty-eight cities which have free service in the manner in vogue in other states in the Union.

A new periodical is *The Modern City*, 32 pp. and cover, published at Hammond, Ind., J. E. Cowgill, Board of Trade, editor and manager.

Practical Street Construction is the subject of a book by A. P. Folwell, recently issued, which is excellent from the standpoint of design of a practical street. Municipal Journal Co., New York.

Bulletin 390 of the U. S. Office of Public Roads gives the public road mileage and revenues in totals for each state for the year 1914.

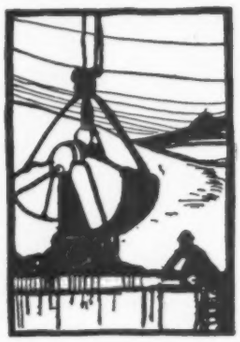
Report of Board of County Road Commissioners of Wayne County, Mich., for 1916. Edward N. Hines, Chairman.

"Highway Laws of the United States," is a topical discussion by A. N. Johnson issued by the Bureau of Municipal Research, 261 Broadway, New York. Paper, 163 pp., $1,00.

The Municipal Year Book of the City of New York, issued by the Municipal Reference Library, 512 Municipal building, for 20 cents postpaid, gives brief but clear descriptions of the duties and activities of the many departments, boards, commissions, bureaus, etc., in the city and a few statistics of revenues, public improvements, etc.

Raymond W. Parlin's paper before the American Society of Municipal Improvements on "Flushing; Its Place in the Street Cleaning Field," can be obtained in separate pamphlet form from the New York Bureau of Municipal Research.

Water Survey, Series No. 13, of the University of Illinois Bulletins, contains the report for 1915 of the Chemical and Biological Survey of the Waters of Illinois. Edward Bartow, Urbana, Ill. The book of 381 pp. contains also a number of papers and reports of investigations made on chemical and bacterial contents of water and their treatment, pollution of streams and the effects on fish, typhoid fever, methods and materials for treating water, experiments on activated sludge, sewage treatment and use of the sludge, etc.



MACHINERY AND SUPPLIES

South Bend Hose Wagons

The fire department of New York City reports the delivery of 5 South Bend double-duty type H-70 hose wagons as well as 3 South Bend double-duty type C-H-70 combination hose and chemical trucks.

The first two high-pressure motor hose trucks as well as the first combination hose and chemical wagons delivered were immediately placed in service in the high-value district covered by the high-pressure system. The high-pressure cars carry 1,200 feet of 3-in. hose, while the combination (aside from the chemical equipment) carries 1,200 feet of 2½-in. hose.

These South Bend double-duty outfits recorded a perfect score after their twenty mile run over the hilly portion (15 per cent. grade) of Manhattan. They averaged thirty miles per hour in the congested districts, thus making this average an enviable record when we consider the many turns and twistings and the grade crossings which had to be negotiated.

The combination hose and chemical, which carries two 40-gallon chemical tanks, is equipped with 36 by 5 solid front and 36 by 4 dual solid rear tires. These outfits are equipped with hub-odometers instead of speedometers.

One of the noteworthy features as noticed in the equipment consists of the two independent ignition systems. The one system is operated in conjunction with two storage batteries and the lighting outfit, there being a switch for the cutting in on either battery with the ignition system while using the other battery for the lights. Either ignition system may be operated alone or both systems may be operated at the same time.

The high-pressure hose wagons carry high-pressure turret nozzles with two 2-way 3-in. siamese connections, one on either side of the body. These wagons have extra long hose bodies with the center partitions thus enabling the department to run out two lines of hose at the same time.

The first three delivered were installed in Station No. 17 which is ranked as the fastest station in the city.

Heltzel Skips Find General Use

A considerable amount of favorable comment relative to the economies effected by unloading cars with Heltzel skips instead of the old "gondola to truck" method, has been heard recently. As these comments originate in widely separated parts of the country, the indication is that contractors have been thinking hard on efficiency methods.

When asked recently relative to the saving made by the Heltzel skips he had installed, Wm. Tonkel of Fort Wayne, Ind., said: "We firmly believe that real efficiency methods are coming, and that is just what we have applied in unloading our cars. The two Heltzels we put in, have just saved us the price of a motor truck, as the two we now have are doing about as much as three would otherwise, as they are constantly on the move.

"We have just about cut in two the items of salary time and money. The two 2½-ton trucks that we use are filled in an average time of 2 minutes to a load. As far as our experience goes, there seems to be no wear out to these skips."

Frank McInenery, of Easton, Pa., has also had considerable experience with Heltzels and is strongly for anything that reduces unloading time or speeds up the truck. "Our 3-tonners are just about 30 per cent more efficient with two loading skips to help them out," remarked Mr. McInenery, "as we now load one in 2 minutes instead of 15 minutes, which we figure with hand unloading from the gondola. The two Heltzels we have, have been steadily on the job for the past five months, so we have had a good opportunity to size them up."

Another Pennsylvania contractor, J. P. Eyre Price, of Price & Baker, Chester, Pa., brought out still another feature when questioned as to his views of unloading efficiency. "While we are using the same number of shovelers," said Mr. Price, "we are getting the loads out much faster, as the Heltzels have entirely cut out the time loss that was a necessary feature of direct shovel unloading. The shovelers work much more steadily, and the unloading process is over so quickly that our demurrage charges have been practically eliminated."

Much the same opinion was voiced by James Wilson, president of the Warren General Construction Company, Warren, Ohio. "Quite aside from our direct saving in unloading cost," writes Mr. Wilson, "we have been enabled thru the use of our two Heltzel lightning-loader skips to make a considerable saving thru the elimination of demurrage charges. These skips are genuine efficiency aids, and are about the best that we have ever seen."

Tilghman H. Moyer, of Allentown, Pa., is another contractor who has worked out the problems of quick unloading. Mr. Moyer used two Heltzels for transferring material from the car to his 3-ton trucks. "This operation," says Mr. Moyer, "takes us hardly more than two minutes, which seems to us to be quite an item of saving when compared to the nine or ten minutes' loading time which we always used to figure on.

"In our experience we have found that the skips can, if necessary, be fastened to the car by two men, but can be very easily put on by three. We find that our skips are giving us that much-needed quality—ability to stand punishment of hard usage."

Savings even more marked have been made by large industrial companies which have made a study of the loading problem. At the Ohio Works plant of the Carnegie Steel Company 8 Heltzels are in constant operation, working in connection with 30-cu. ft. cars. These cars run on an industrial track, taking material to concrete mixers.

"All our material," said Mr. J. H. Grose, general superin-

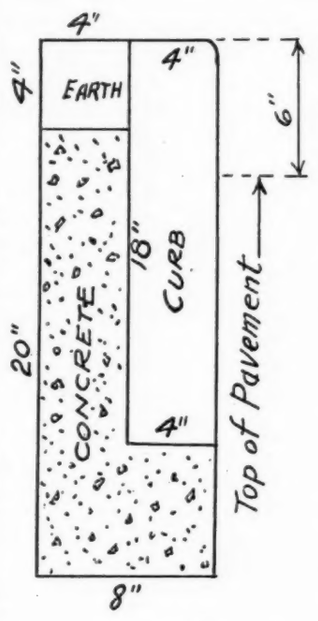
tendent of the plant, "is handled from the railroad cars into the Heltzels, and from there discharged into the small dump cars, which take it to the mixer. It is impossible for us to state how many men we eliminate, due to the use of the loader skips, inasmuch as they are part of our whole system for handling our material. It is only by working the whole system together that we make each unit of it successful. This type of skip is handling our concrete aggregate (slag and sand) and gives equal satisfaction on any of these products. They give a clean discharge, do not leak and are fairly easy to handle. They seem to stand up very well under rather hard usage and are giving very good satisfaction."

Sandstone Curbing in Detroit

"Berea natural sandstone curbing, when placed in accordance with our specifications," states Mr. J. G. Hutzel, superintendent of new paving, Detroit, Mich., "would last for at least fifty years.

"We have used Buckeye Berea sandstone for curbing on residence streets particularly, and this grade of stone, altho first placed 25 years ago, is today in excellent condition.

"So far we have not made a very extensive use of sandstone curbing on streets which are subjected to heavy tra..c, nor for circles at intersections of streets and alleys. For circles and retaining stone we have been using granite.



"We now have over 500 miles of natural sandstone curbing on our streets and will this year lay approximately 35 more miles. Our specifications call for the curb to be 18 in. high, 4 in. thick, no stone to be less than 3 ft. long, top and breast to be neatly dressed with tooth chisel and bullnose 1¼ in. by 1¼ in. on the street side to be neatly dressed off.

"The curb is set on a 6-in. concrete bed and is backed up with a 4-in. concrete wall to within 4 in. of the top. The line adjoining the earth or sidewalk is pitched off at 4 in. The concrete for this work consists of 1 part cement, 3 parts of sharp, clean sand, and 6 parts of ½-in. crushed stone. This concrete adds a great deal of strength to the curb and prevents the frost heaving it up or down or pushing it out of line."

Away with the Wheelbarrow!

As a means of bringing brick up to the setters on a paving job, the wheelbarrow seems to have outlived its usefulness. At least that is what a number of prominent contractors have decided as a result of their search for more efficient methods.

"There is a new era in the paving business," is the way Roehl Brothers, contractors, of Cleveland, Ohio, express it. "We have long since wiped out the old practice of using wheelbarrows to place brick for the pavers, and are using gravity carriers (Mathews type) exclusively. We would not think of going back to the wheelbarrows.

"In our operations we use two sections of carriers. By using four men to each section (two men placing brick on the carriers and two men taking brick off and placing them for the setter), it is no trouble to handle 40,000 brick in an 8-hour day. If we were to handle the same amount of brick by the old wheelbarrow method, we would have to use four men in addition to the number required to operate with the carriers, thus necessitating twelve men where we now do the same amount of work with eight. As far as adroitness is concerned, we find it is impossible to do good work without skilled help. The men who are taking off the brick and setting them must be good brick handlers, which we consider skillful. The men who are putting the brick on the rollers must also be good brick handlers. We find it takes good men to do good work.

"It also can be noticed that the carriers have helped to reduce the number of culls, such as broken and chipped brick, which always happens when dumping the brick from the wheelbarrows, thus saving a number of good brick that would otherwise be culled out because they are chipped. The men also appreciate the carriers in the fact that setting brick with the carriers is less tiresome by far than the old wheelbarrow method.

"With the labor troubles that contractors are experiencing at the present time and without any relief in sight, a saving of four men is a big item, and with the very wide margin that the price of labor has, one can easily see if the price of labor keeps on advancing, the saving in the use of gravity carriers will keep increasing. Our data as to saving are shown below, figured on an 8-hour basis, in which we handled 40,000 brick."

With Mathews Gravity Carriers.

Two men putting brick on rollers at $2.75 per day	$ 5.50	
Two men taking brick off and setting at $3.00 per day	6.00	
	11.50	
Two sections	11.50	$23.00

With Wheelbarrows.

Nine men wheeling at $2.75 per day	$24.75	
Three men setting brick at $3.00 per day	9.00	$33.75
Wheeling cost	$33.75	
Carrier Cost	23.00	
Saving per day	$10.75	

According to John R. Kennedy, of C. Kennedy & Son, Parkersburg, W. Va., this same gravity conveyor not only reduces labor cost, but actually cuts down the percentage of chipped and broken brick.

"We can handle brick much more economically with the Mathews than was possible by the old wheelbarrow method," says Mr. Kennedy, "as it requires only about one-half the number of laborers.

"In using the wheelbarrows it was necessary to have two gangs, one wheeling and one setting up the brick to the brick layers. With the use of the Mathews carrier the wheelbarrow gang is eliminated and the brick is delivered to the layers in better condition, that is, not chipped or broken. With two good bricklayers and 10 or 12 laborers we can lay 50,000 brick per day by handling the brick over the Mathews carriers.

If the opinion of a large user is of any greater weight than that of any other experienced person, the testimony of the Stamey-Mackey Construction Co., should be important. This concern has been handling a large quantity of brick with the gravity system, having in use eight or ten sections of Mathews gravity carriers.

"Our carriers," said Mr. Stamey, in speaking of the efficiency methods he employed, "are all in the 8-ft. length so that they will fit various widths of streets.

"Unless the street is exceptionally wide we use one set

of conveyers to each man setting. We find that better time is made by having the brick setters divided up, using several gangs of this kind, than is made with more than one setter or layer to each conveyer. Of course, if the street is 40 feet or more in width then we use two setters. For a narrower street where we are using two or three sections 8 feet long, we use one setter, two men taking brick off the conveyer and setting them in place for the setter and two men taking them from the pile along the curb and putting them on the conveyer.

"A gang of this size will set 600 yards of 3-in. vertical fiber brick or about 20,000 brick in 8 hours. Before using the conveyers, we had 7 men with wheelbarrows for each setter. The chief disadvantages with wheelbarrows were in chipping brick and displacing the ones already laid. If I were a brick manufacturer, I would insist that the contractors use these conveyers as they save many a brick on a year's work."

A slightly different method of using the conveyers is carried out by Stipes & Pilcher, of Champaign, Ill. "We do not handle brick off the parking," writes Mr. Edw. S. Pilcher, of that company, "but take them off the wagons instead and lay them directly into the street. We commence laying brick at the end of a street or intersection and then place 2 by 12 boards for a track to run our loaded wagons on so as to bring them at all times up to the brick laying. In this way, we only handle our brick once.

"On each side of the wagons we use a 16-ft. carrier and have two men putting the brick on each carrier and two at the other end, stacking them for the brick setters. Our average is 35,000 brick laid in a day, all of which are handled with the carrier and it takes eight men to put them on and take them off. We are not compelled to handle the brick so many times and in muddy weather the brick come to the setters clean and the men are not tracking mud in on the new brick before the filler is poured. We always have the right number of brick at hand where if they are stacked on the parking in some places you are a few short or have some left to pick up when the job is finished."

The Mathews gravity brick conveyers referred to by these contractors are all-steel ways provided with rollers over which the brick are carried by their own weight to the setters. They are easily moved on casters which are provided, and are built very strongly to stand the hard usage they are sure to encounter.

Cummer Plants on Large Yardage Jobs

Proof of the ability of the Cummer portable road asphalt plant to handle the biggest sort of a paving job speedily and with uniformity was given by the work that one of these plants did for the city of Elizabeth, N. J., last year. During the year, the Continental Public Works Co., of New York, put down in Elizabeth approximately 40,000 yards of sheet asphalt all prepared with the Cummer machine.

All of this asphalt was laid on a 6-in. concrete foundation. This was a 1-3-6 mix, and was prepared with Koehring mixers, a No. 14 and a No. 16 being used in the work.

On account of the large quantity of asphalt used the entire supply was delivered in tank cars. After being heated by steam coils it was pumped direct into the kettles for further heating. For this work, coal fires instead of steam were used, the heated material then being either pumped or ladled into the measuring boxes. The asphalt then went to the mixer.

The 1,250-yd. Cummer plant which the Continental Co. used on this job is one especially adapted to road work. A sand drum 54 inches in diameter and 13 feet long gives it a capacity of 12 tons of dry sand per hour. The sand bin is divded into two compartments having 6½ tons total capacity. This double bin is provided with rotary screen. In order that each ingredient may be weighed separately the measuring box is put on a 2-beam scale. The mixer is steam jacketed and has a capacity of 7 cu. ft. The asphalt bucket is hung on a 125-lb. capacity double-beam scale.

Sand for the Cummer plant is carried up by a chain bucket elevator, and the hot asphalt is taken up by a similar one. The power plant of the whole machine is a 30-h.p. steam engine.

Even a larger job than the one above was handled by the same plant in the Province of Quebec, Canada. On this work, which Quinlan & Robertson put down, 350,000 sq. yds. of sheet asphalt and 200,000 sq. yds. of Topeka were laid. Two plants were used on this work, the 2,000-sq. yd. railroad plant and the 1,000-sq. yd. portable. Both were worked considerably above capacity.

Quinlan & Robertson in telling of the performance of their portable plant said recently: "Our 1,000-yd. Cummer portable road asphalt paving plant turned out as high as 1,500 yards per day and there were no delays worth mentioning in all of the work. Asphalt for the jobs was heated by standard steam and air process before being delivered to the mixer. Our dryer was the standard Cummer dryer."

Vibrolithic System of Laying Pavement

By R. C. Stubbs, Dallas, Texas.

More than thirty years constant use and study of portland cement and its products has not convinced me that plain concrete is the full answer for municipal and highway pavements, believing that more of the operation should be intrusted to special machines, eliminating as far as possible the unsteady human hand with its personal equation.

The simple method of applying vibration and pressure, used in the placing of vibrolithic, is extremely efficient, flexible, and foolproof, following the mixer and raker over any width of street of any crown, including any combination of intersection formation without change or the slightest variation of efficiency.

KOEHRING PAVER AND PATENTED GASOLINE ENGINE VIBRATOR AS USED IN CONSTRUCTING A VIBROLITHIC PAVEMENT AT WHITE LAINS, NEW YORK.

I recognize the importance of uniform abrasive value in the surface of the slab under traffic, and know that mortar and coarse aggregate would vary in this value, and that it was impossible to secure a surface with uniform amount of either, even with the most carefully compounded and mixed concrete spread and leveled to grade in the street. The vibrolithic system meets this demand by spreading upon the surface of the placed concrete a casting of hard stone immediately ahead of the vibrators that send it down into the surface constituting it a part of the mass, leaving an effectually armored slab behind.

Experience taught me that no concrete is better than its curing, because the period of hydration can be no longer than the moisture state of the mass. I knew that concrete could be forced to retain its moisture in but two ways: One by surrounding the mass with moisture; the other by insulation to prevent evaporation. I was not convinced that it was practical to undertake to keep slabs of large area moist by sprinkling under high temperatures, too much chance for neglect, and in case of sudden drop of temperature below freezing point the water would be no barrier to frost. The vibrolithic system provides an effectual insulation while original moisture is yet in the mass, forcing same to remain for a long period of hydration, shutting out frost in the meantime. The insulating property is in an effectually stuck tar carpet that remains to shield the surfacing stone from actual contact with traffic until the cement bond has sufficient age to resist the shock, since concrete is not concrete until it has an age of several months or even years, for that matter.

I would not have you believe that I claim vibrolithic to be perfect, but the system recognizes laws of nature and traffic not admitted to exist by others, but that are believed to be important by the engineer who knows concrete.

The pavement is laid without expansion joints at the curbs, but with transverse and longitudinal joints of ½ by 3-in. boards left in the bottom half of the pavement. These divide the pavement into slabs 30 feet long by half the width of the pavement. The upper 3 inches of the pavement, however, is monolithic, the joints merely being designed to form vertical planes of weakness where the slabs will crack uniformly instead of irregularly, if they crack at all.

After the concrete is a day or two old a high-speed revolving broom is passed over the surface, and any laitance and surplus mortar is removed, leaving a clean hard stony surface. On this surface is immediately spread a hot tar carpet, covered with pea stone or grit.

The object of the tar carpet is chiefly to protect the concrete during the curing process. It is designed to retain the moisture in the concrete until a complete set has occurred and to save the green concrete from the abrasion of traffic. The tar carpet is claimed to make it unnecessary to keep the concrete dampened or covered with water or earth, as in ordinary practice.

The distinguishing feature of construction, the use of a vibrator, unquestionably produces a very dense concrete. Pieces broken out of old pavements show the stones in close proximity to each other and a smooth, flinty plane of cleavage characteristic of a dense and thoroly hydrated concrete. Both the vibrator and the process involving its use are patented. The machine itself is merely a 4-h.p. motorcycle engine mounted on a steel frame with steel roller wheels. The pulsations of this unbalanced engine are about 1,000 per minute.

The developer of this method of construction sums up its advantages as follows: The vibrations produce density in the entire mass, permit the economical addition of broken stone in the upper portion of the slab and bring to the surface a rich dense mortar to bind the added stone, while the stones being at or near the surface form the ultimate wearing surface. The seal coat of tar covered with pea stone, chats or torpedo sand forms the temporary wearing surface, improves the looks of the pavement, makes it noiseless, gives it a non-skid surface and aids in the uniform curing of the concrete.

Trenching Machine Work

By William W. Brush, Deputy Chief Engineer, Bureau of Water Supply, Department of Water Supply, Gas and Electricity, New York, before the American Water Works Association.

In 1909-1910, the City of New York installed between Valley Stream and Amityville, Long Island, (a distance of 83,800 feet) a 72-in. lock bar 7/16-in. steel pipe as a portion of its Brooklyn conduit system. The contract which was dated November 6, 1908, was awarded to the T. A. Gillespie Co., and the total estimated cost for all the work which included culverts, valve chambers, valves, and other appurtenances, was $1,879,390.

That portion of Long Island traversed by the pipe, is an almost level sandy plain, there being only a few feet difference in elevation between the small valleys and the low intervening ridges. The material to be excavated was sand with some gravel and a light sandy top soil. A right of way, in general 200 feet in width, with few cross roads gave opportunity for the use of any excavating system.

The contractors used practically every known method in excavating the trench, including hand, horse and scraper, clam shell buckets, steam shovels, and the Austin trenching machine. The trenching machine was used for the greater part of the work. It could be and was operated from the shallowest trench section up to a maximum depth of about ten feet, the limiting depth being determined by the resultant width of trench, it being necessary to have a secure track foundation on each side of the trench on which the machine travelled, and by which it was supported. Where the depth of the trench was greater than 10 feet, the contractor removed a portion of the material by other methods and then used the trenching machine.

In a section where the average depth of cut was 8 feet, and the work was performed during a period of one month, data are available on which accurate determination of the cost of excavation by this method can be worked out.

Two machines were regularly employed, working in tandem, one machine removing approximately half the material and the other machine completing the trench. This method was considered to give maximum rate of progress. The contractors were desirous of completing the work as rapidly as possible and the methods adopted were based first on progress and second on unit cost.

The two machines used were not owned by the T. A. Gillespie Co., but were rented from the F. C. Austin Drainage Excavator Co. at a yearly rental of $8,500 and $9,300, respectively. This rental was based on the total yardage excavated by either machine being 100,000 cu. yds. or less, all over and above 100,000 cu. yds. being paid for at the rate of $0.055 per cu. yd. The machines were worked in tandem for the greater part of the work and in many cases for the 24 hours in each day.

To determine the cost per cu. yd. for excavating the trench by use of the trenching machine, a length of trench was taken extending from Sta. 96,952 to Sta. 109,092 or a total of 12,140 feet. The machines were worked in this section three shifts per 24 hours for one month from May 15 to June 16, 1909. An accurate force account was kept by the department for this period.

The total cost of excavating per cu. yd. was subdivided under the following:

(1) Rental of machines
(2) Repairs and coal for machines
(3) Labor force.

The total amount of excavation made by the two machines was approximately 400,000 cu. yds. or 200,000 cu. yds. for each machine. The cost for rental per cu. yd. would therefore be for

Machine No. 1, the first 100,000 cu. yds.....$0.085 per cu. yd.
the second 100,000 cu. yds.... .055 per cu. yd.
Machine No. 2, the first 100,000 cu. yds..... .093 per cu. yd.
the second 100,000 cu. yds.... .055 per cu. yd.
The average for both machines would be $0.072 per cu. yd.

The trenching machine excavated the trench with side slopes of 1 on 1 and the bottom of the trench rounded to

conform with the curve of the pipe. The average depth of the trench for the 12,140 feet excavated was approximately 8.0 feet. This gave a total of 48,500 cu. yds. or 4 cu. yds. per linear foot of trench. The repairs on the two machines for the first six months, including the cost of setting up, amounted to $6,000 and the cost of coal for the same period was $2,000. The cost for repairs, coal, etc., for one month would be $1,334 or $0.0275 per cu. yd.

The force included:

(a) The men who operated the machines,
(b) The gang laying and shifting the track and moving machines,
(c) The gang who trimmed the trench to grade after the machine had passed.

This force was as follows:

General foreman, 2 months at $125	$ 250.00
Foreman, 143.5 days at $2.50	358.75
Laborers, 2,368 days at $1.40	3,315.20
Teams, 266 days at $5.00	1,330.00
Boys, 45 days at $0.75	33.75
Engineman, 176 days at $4.00	704.00
Foreman, 171 days at $3.00	513.00
Foreman, 171 days at $3.00	513.00
Skilled laborers, 15 days at $2.00	30.00
	$6,534.70

This cost of labor shows a cost per linear foot of trench of $0.5382 and a cost per cu. yd. of excavation of $0.1345.

The total cost for excavation would be:

Rental of machine	$0.072 per cu. yd.
Repairs and coal for machine	0.0275 per cu. yd.
Labor	0.1345 per cu. yd.
	$0.2340 per cu. yd.

This cost per cu. yd. is equivalent to $0.936 per linear foot of trench.

The following summary of cost of laying the pipe will enable a comparison to be made between the excavation cost and that of other factors in the work:

Clearing and grubbing	$0.037	per lin. ft.
Excavating	.928	per lin. ft.
Unloading and distributing	.1911	per lin. ft.
Laying	.2166	per lin. ft.
Digging bell holes	.084	per lin. ft.
Riveting	.345	per lin. ft.
Calking	.288	per lin. ft.
Testing	.24	per lin. ft.
Backfilling	1.061	per lin. ft.
Cleaning up, etc.	.0994	per lin. ft.
	$3.49	per lin. ft.

It is interesting to note that on this job, the backfilling cost 15 per cent. more than the excavation. The usual experience warrants an estimate to backfill at a materially lower cost than the excavation.

New Kahn Built Bridge

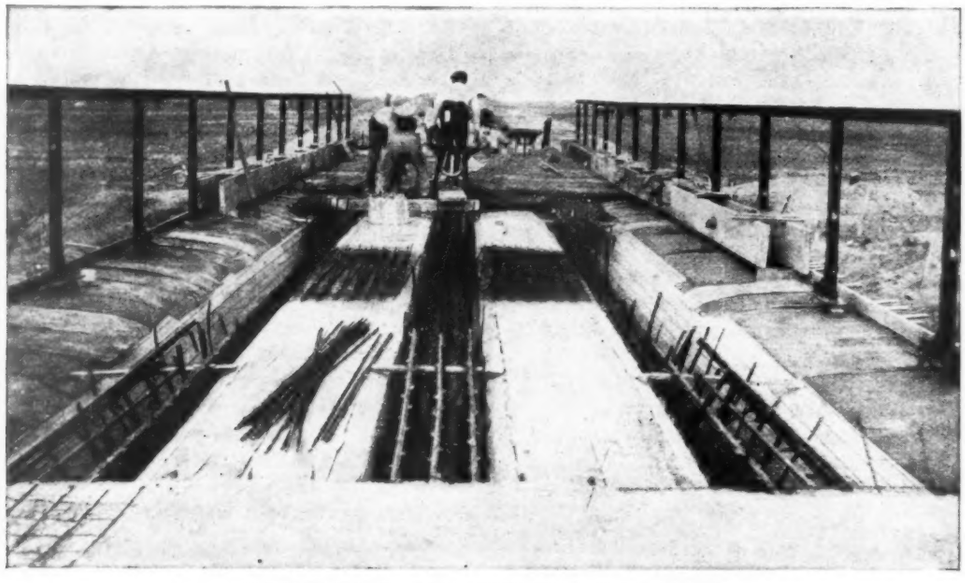
That South America is keeping well abreast of the times in the matter of concrete bridge construction is evidenced by the Kahn system bridge which was recently constructed as a highway bridge across the Salado or Salt river. This bridge is approximately 145 feet long, and is of a clear Kahn type, similar to other structures that the company has erected in other parts of Argentina.

Fully two months of the work were carried forward under extremely trying conditions owing to the heavy February and March floods. The Salado river carries drainage from a large territory, taking the water into a wide expanse of marsh. It is across this marsh at the town of Tintina that the new bridge is constructed.

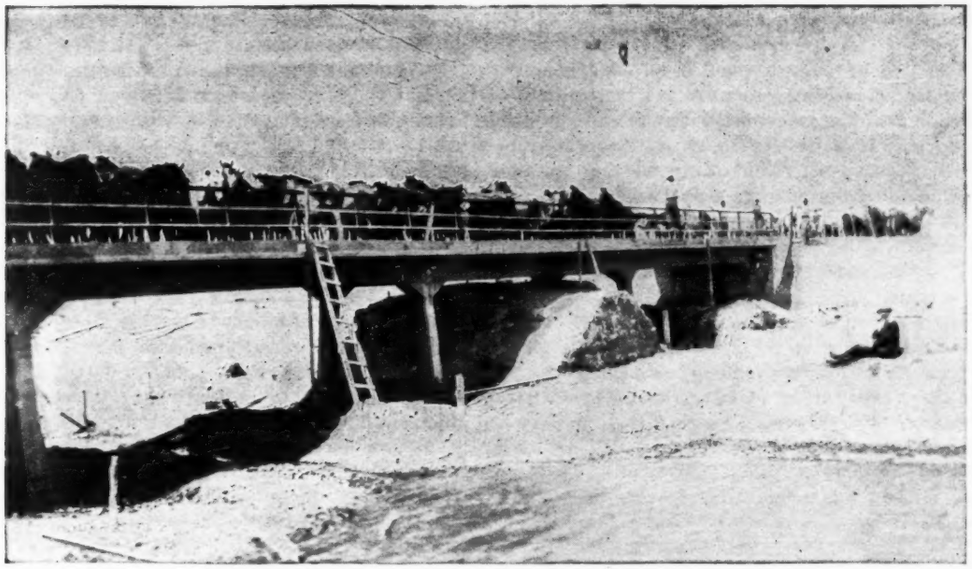
In every place that concerned mud and high water, the construction problem was a difficult one. While the marsh at low water was only a series of disconnected pools, at high water it covered three miles or more of the flat valley. At bottom was a white clay, very soft in consistency, which could not be crossed with safety except in the dry season.

Owing to the soft bottom it was decided to construct the foundation by sinking piles to a great depth to form a solid foundation. With the possibilities of Kahn beams which are so light, and which have at the same time such an exceedingly great sustaining capacity, the contract was accepted, and a good profit was made.

The superstructure of the bridge is of Kahn standard type with inclined supports. The abutments and the retaining walls for earth show an idea of Messrs. Malmquist which was very little known there, which consists of supporting the sides upon the foundations under the beams, in this way form-



KAHN BAR BEAMS IN SALADO RIVER BRIDGE.



LOADING TESTS ON KAHN SYSTEM BRIDGE.

ing a monolithic construction of light weight, perfectly safeguarding the embankments against the waters rushing underneath.

The principal beams are provided with the famous Kahn bars, and as these bars are rigidly connected with the abutments, they stay in their place once they have been placed, and it is impossible for the workmen to make mistakes on account of carelessness, for which reason the Kahn bars have received the nickname of "fool-proof bars."

The covering of the bridge is of the Kahn reinforced type, with rib metal, which is furnished in large sheets and can be easily handled, so that it is not necessary to bind it with wire, and the uniformity of all sections is assured.

Credit for the successful completion should be divided between Malmquist y Cia., who had complete charge of construction work, and the Trussed Concrete Steel Co., which manufactured the reinforcing and structural steel material.

The Merriman 2,000-yd. Railroad Asphalt Plant

The Merriman asphalt plant made by the East Iron and Machine Co., Lima, O., consists primarily of a heavy steel frame mounted on heavy trucks, on which are mounted the boiler, drying drum, asphalt kettles, mixer, sand-storage and weigh-box, screens and hot and cold elevators, ready for the preparation of asphalt binder and asphalt topping.

The cold sand or stone is fed by elevator into one end of the drum for thoro drying and is conveyed to discharge by internal spiral flights. By the hot elevator it is conveyed to the screen which removes any oversized material and discharges into the hot material bin and drawn as needed thru gates operated by levers into the weigh-box and thence into the mixer.

The melting kettle has two compartments, each with agitators, valves and manholes, for convenience and economy in charging with cold and drawing hot asphalt. The barrels are usually stripped, the asphalt cut up and weighed on the ground and raised by a rotary steam hoist and crane to the kettles which have large manholes in the top. The flux is pumped into the kettles by an oil pump. After charging manhole is fastened on, and steam is turned into the coils within the kettles, thus obviating any burning of the asphalt, a danger with direct fire heat.

The agitator systems are equipped with valves to allow either steam or air agitation. The melted asphalt is conveyed from either kettle thru a steam-jacketed line to the asphalt weigh-box, and then dumped into the mixer. The dust is kept in storage on the mixer platform convenient to the mixer. A dust elevator can be furnished altho not a part of the regular equipment. After mixing, the batch is dumped direct into the wagon, the mixer platform being high enough to permit driving under.

Particular attention is called to the completely steam-jacketed asphalt pipes and fittings, which save valuable working hours thawing out A. C. lines. Attention is also called to the separate power units, making a smooth-running plant and eliminating complete shut-downs as may occur with one engine only.

This plant is 9 feet wide, 14 feet high, and 65 feet long as shipped, being increased in operation 8 feet 6 inches by the extension of the mixer platform. The end of the cab, which drops to form a firing platform for the boiler also adds about 9 feet of length.

Air brake equipment and automatic couplers at each end meet the M. C. B. and Interstate Commerce Commission rulings.

The true shape of the drying drum is insured even after excessive firing, by heavy cast-iron spiders and channel reenforcement. By means of spill plates and cascading a constant and thoro agitation is obtained by this method which will dry material very promptly. All moisture is carried out thru the stack by the hot furnace gases. The drum revolves 8 r. p. m. and it takes about three minutes for material to pass thru it. One contractor took his sand from the lake bed with a scraper and ran it directly thru the drum and kept his plant up to its full capacity, showing the efficiency of the system.

The kettles are well stiffened with angle irons and tie rods. Clean-outs are placed in the bottom of the long leg and also just above the false bottom of the kettle. Safety valves prevent excessive pressure. Agitators are provided and electrically welded pipe coils in each kettle, all condensation being returned to the boiler by the feed pump, thus saving water. Kettles hold 1,265 cu. ft. of asphalt allowing 8-in. space at top.

The tubular marine boiler has about 931 sq. ft. of heating surface. The boiler, 15-h.p. drum engine and gearing for cold stone and sand elevators, throwing either one out of gear, are in the same steel cab, also the air compressor with which to

agitate asphalt in kettles and force liquid asphalt to the weigh-bucket.

The hot material storage bin, of about 3 cu. yds. capacity, is sometimes doubled on special order by increasing height on the bin. Enclosed angles are placed inside the bin for placing of partitions if it is desired to screen material into two or more sizes. Special bins containing more gates and partitions can be supplied for making asphaltic concrete and bitulithic.

The mixer is driven by a direct-connected 25-h.p. horizontal engine. The hot sand elevator is driven by an independent 5-h.p. horizontal engine.

The mixer engine, hot elevator engine, and the rotary engine for the hoist are placed on the movable mixer platform, which rests directly on the plant frame when packed and is extended 8½ feet by heavy screws running in babbitted nuts, when set up for operation.

The hot-sand or hot-material bin is raised to its working height by heavy screws working in babbitted nuts. All exposed machinery on the mixer platform is covered with a sheet iron housing.

Low Cost of Handling Water by Gas-Engine-Driven Centrifugal Pumps

The cost of pumping water is made up of two principal elements, viz., first, the fixed charges consisting of interest, repairs, maintenance and depreciation, and second, the cost of fuel. The fuel cost varies inversely as the duty of the engine, but on the other hand reciprocating engines showing the highest duties may also be the most costly, so that what is gained on fuel consumption may be lost in interest and depreciation charges.

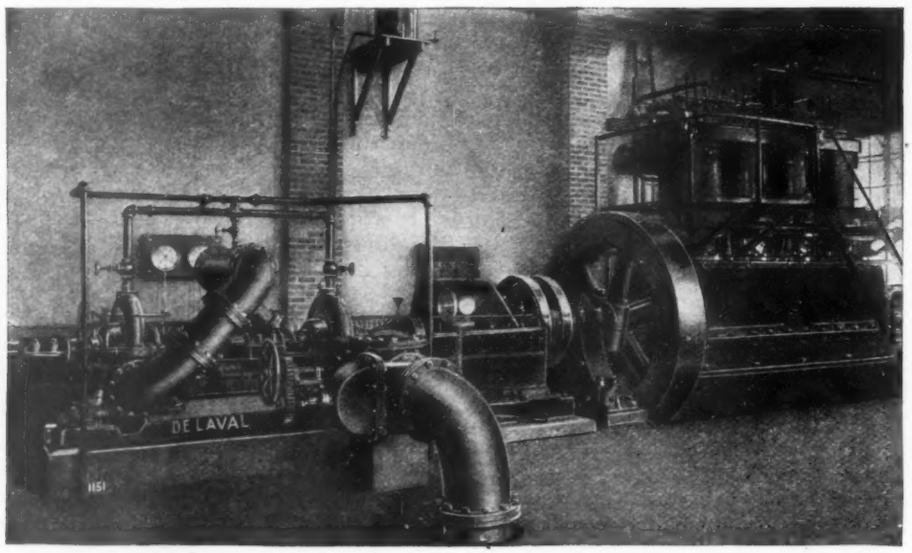
For example, a comparison of the 1,100-h.p. triple-expansion pumping engine at the Bissels Point Station, St. Louis, which upon test showed a duty of nearly 203,000,000 feet pound per 1,000 pounds of steam, with the 1,200-h.p. steam-turbine-driven pump at the Kirtland Station of the City of Cleveland, which showed a duty of slightly over 152,000,000 feet pounds per 1,000 pounds of steam, developed the fact that the unit showing the lower duty was the more economical. The total cost of the reciprocating equipment, including buildings, foundations, boilers and boiler plant complete, was about $195,000, while for the steam-turbine-driven centrifugal pump, it was about $84,000. Assuming both stations to use coal costing 1.70 per ton, the total cost of pumping with the centrifugal pump was $23.08 per water-horse-power year of 365 days of 24 hours each, as against $27.60 for the reciprocating pump. Of these amounts, approximately $17.50 for the centrifugal pump and $13.50 for the reciprocating pump represented fuel.

In some localities natural gas of high heat value can be obtained at remarkably low cost. Taking advantage of this fact and of the superior efficiency of the gas engine as compared with the steam engine, the City of Clarksburg, W. Va., has been able to reduce the fuel cost of pumping to about $7.00 per water-horse-power per year.

The pumping equipment recently put in service at Clarksburg consists of a 50-h.p. gas engine driving thru speed increasing gears a 4,000,000-gal. per day De Laval centrifugal pump, which delivers water against 35 feet head to the filter bed, and a 350-h.p. gas engine running at 200 r. p. m., driving thru double-helical speed-increasing gears a De Laval two-stage centrifugal pump, delivering 4,000,000 gallons per day against 350 feet head to the city reservoir. The latter unit is illustrated herewith.

The gas engine was guaranteed by the maker to deliver a brake horse-power on 10 cu. ft. per hour of gas of a heating value of 1,000 B. t. u. per cu. ft. During a ten days' continuous run the total consumption of the high-service and low-service pumps together was found to average 82,200 c. ft. of gas per day. During this run the capacity was kept up to 4,100,000 gallons per day, the high service pump delivering against about 330 feet head, and the low service pump against 30 feet head, a total of about 258.5 water-horse-power. The gas is received from wells near by belonging to the city and is charged for at 6 cents per 1,000 cu. ft., altho the commercial power rate in that locality is about 8 cents. The fuel cost of a water-horse-power would be $6.96 per year at 6 cents and $9.27 at 8 cents.

Formerly water was supplied by engine-driven centrifugal low-service pumps and duplex direct-acting high-service pumps, receiving steam from gas-fired boilers. With this equipment the gas consumption was about 350,000 cu. ft. per day, at a pumpage rate of approximately 3,000,000 gallons. When additional capacity and new equipment became necessary, the Clarksburg Water and Sewerage Board, and their engineer, Geo. W. Fuller, made a careful investigation of the



HIGH PRESSURE GAS-ENGINE-DRIVEN CENTRIFUGAL PUMP OF THE CITY OF CLARKSEBURG, W. VA.; CAPACITY 4,000,000 GAL. PER DAY AGAINST 350 FT. HEAD; ENGINE SPEED 200 R. P. M.; PUMP SPEED 1,385 R. P. M.

following: steam-driven centrifugal pumps, steam-driven crank-and-fly-wheel pumping engines, gas-engine-driven direct-acting pumps and gas-engine-driven centrifugal pumps.

The preliminary estimates showed that the best gas consumption with steam-driven pumps would be about three times that of gas-engine-driven pumps and, in view of the rapid depletion of the natural gas supply in the neighborhood, it was deemed advisable to put in the more economical, altho more expensive, equipment in order that the city's gas wells might last as long as possible.

Bids were finally requested on gas-engine-driven direct-acting pumps and gas-engine-driven centrifugal pumps. The units offered by the Dravo-Doyle Co., of Pittsburg, involving the use of double-helical speed-increasing gears driving high-efficiency, high-speed centrifugal pumps were accepted because of the high over-all economy and the greater simplicity and lower expense for maintenance of the centrifugal type of pump, together with saving in floor space and a very material reduction in the first cost of the equipment.

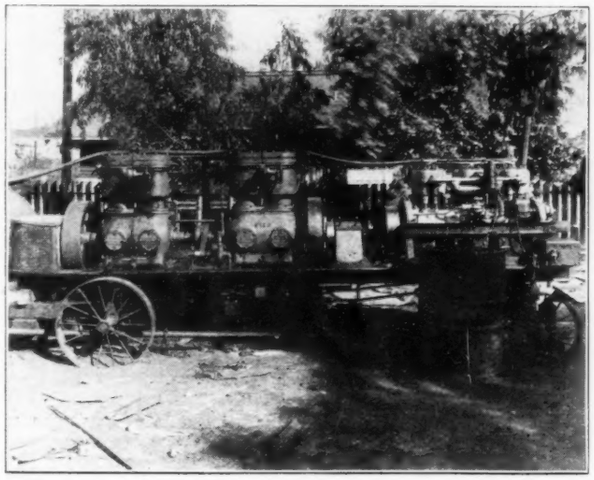
The complete cost of the pumping equipment, was approximately $17,500. The cost of the substructure, superstructure, crane, piping and appurtenances complete was $13,905, or a total of $31,405. The annual interest, depreciation and upkeep charges upon this amount at 8 per cent. would be $2,512.40 per year, or $9.71 per water-horse-power, giving a total cost of pumping, exclusive of attendance and supplies, of $16.67 per water-horse-power year of 365 days of 24 hours each. For 16 hours operation the cost would be $14.35. These figures compare favorably with those previously cited for much larger steam-driven pumping units.

New Asphalt Repair Wagon

To meet the demand for an asphalt repair outfit of low cost and available for the use of municipalities where no asphalt plants are located, the Iroquois Works of The Barber Asphalt Paving Company have devised an asphalt repair wagon capable of supplying material for from 50 to 75 sq. yds. of patching per day. The total weight of the outfit is only two tons. It can be used to remelt old asphalt paving or cakes of new mixture made at a larger plant and stored, for heating sand and stone with asphalt cement to make new mixtures, and as a sand, gravel or stone drier or substitute for a melting kettle. The wagon is supplied with a full outfit of paving tools.

Interesting Compressed-Air Outfit

The accompanying photograph shows an interesting installation of a Wisconsin motor in Los Angeles, Cal. The motor is shown driving two double 8 by 6 Rix-Gardner air compressors, with a capacity of 280 cu. ft. of air per minute, against 125 pounds working pressure.

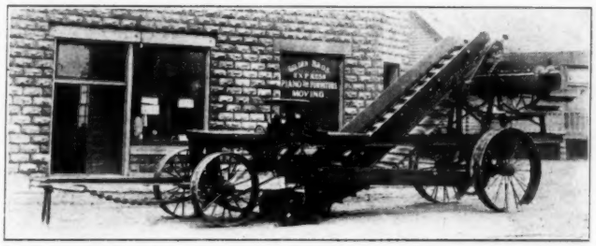


This motor has 5 cylinders with a 5¼-in. bore and a stroke of 7 inches. The speed of the motor is 800 r. p. m., and of the compressors 400 r. p. m. The Los Angeles job has a 10-hour operating day, furnishing aid for pneumatic hammers and drills.

The motor is that of the Wisconsin Motor Manufacturing Co., Milwaukee, Wis. The Gardner Governor Co., Quincy, Ill., and the Rix Compressed Air & Drill Co., San Francisco, Cal., are responsible for the air compressors.

Combination Grader and Loader

The combination grading and loading machine here illustrated has been devised and perfected to reduce the cost of all grading operations. It consists of a plow and scraper with a conveyor and cross-conveyor which carries the material shoveled from the roadbed directly into a wagon which follows the machine.

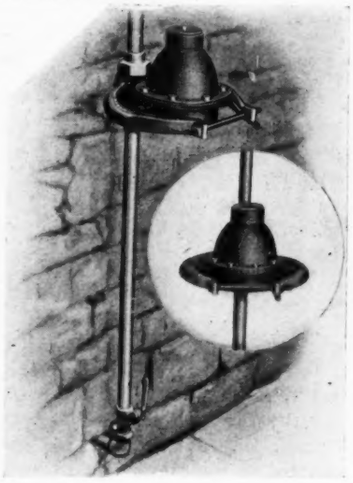


It is claimed that the only limit of this machine is the power of the tractor attached to haul it, or of the teams hitched to it. With a 24-h.p. road tractor the inventor states that it will load 2,000 yards in 10 hours and that it will handle any and all kinds of material that a wheeled scraper can take care of.

The machine was devised and will be manufactured by Harry L. Barton, of Gary, Ind.

A New Vertical Pipe Meter Frame

To meet the demand for a cheap practical device for setting meters on basement pipes the Ford ram's horn meter yoke has recently been perfected.



Claim is made that this yoke not only costs less, but is much easier to install than the ordinary meter fitting. By its use a means is offered for standardizing basement meter settings.

As shown in the illustration the yoke consists of two hollow

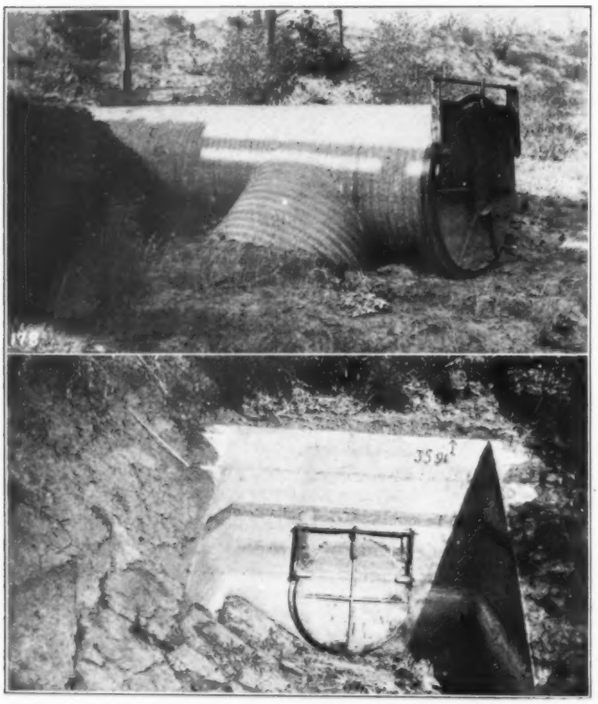
pivoted members, thru one of which the water flows to the meter, the other carrying it to the house service pipes. A single nut clamps the meter between the two members of the ram's-horn setting and sealing the meter is thus made easy.

The ram's-horn yoke has the special advantage of offering a very direct path to and from the meter, with extremely little resistance to flow at any point. Each meter is tested to 200 pounds pressure.

Regular meter connections are unnecessary, and the device will take any standard ⅝-inch meter or ⅝-inch meter with ¾-inch spuds.

Automatic Drainage Gates

The accompanying photographs show, one an automatic drainage gate mounted on the end of a corrugated iron drainage culvert where it serves to prevent the back flow of water when the stream into which the culvert discharges rises above the cutout; and the other a similar gate installed on the concrete end wall of a similar culvert.



These drainage gates are automatic, remaining closed unless the pressure of water behind them is enough to open them, and so remaining closed whenever the water in front of them rises above the gate to any extent.

They are used also for discharging drainage water from streets into irrigating or other canals which at times are full enough of water to back up on the streets if the outlets are left open.

Trade Notes

The Road-Maker, heretofore published at Moline, Ill., is now published by the International Trade Press, 515 Monadnock Block, Chicago, Ill. Joe L. Long continues as editor and manager and H. E. Hopkins as managing editor. This organization recently took over the *Cement World* and its latest accession is the *Electrical Review and Western Electrician*.

The Copeland-Inglis Shale Brick Company, Birmingham, Ala., has become a licensee of the Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio, and will henceforth make wire-cut lug paving brick. This is one of the largest and most important paving brick companies in the South.

A. F. Ehrbar is now the general manager of the Duplex Mfg. and Foundry Co., and their office has been removed to Elyria, O.

Grangers Lime Co., West Stockbridge, Mass., is distributing small samples of finely ground limestone dust, suitable for use as asphalt filler and the like.

Trade Publications

The Lehigh Portland Cement Co. has issued the standard specifications and tests for portland cement adopted by the American Society for Testing Materials in handsome board binding. Another publication of the company gives forty-one reasons why concrete should be selected for modern construction, by D. V. Moore, C. E.

Studebakers, South Bend, Ind., have issued a municipal portfolio of handsome reproductions in color of photographs of their various street sprinklers and sweepers, garbage and refuse collection wagons and carts and road oilers.

The Spray Engineering Co., 93 Federal St., Boston, Mass., issue a general catalog, No. 501, briefly illustrating their lines of sprinklers for cooling water, sprinkling lawns and parks, spraying trees, applying bitumen to roads, etc.

Pioneer expansion joints are fully described in a booklet of the Pioneer Asphalt Co., Lawrenceville, Ill., including filler asphalt, premolded joints ready for insertion in the pavement, for concrete, brick and block pavements, with full specifications for the same.

The Sewer Pipe Manufacturers' Association, Akron, O., has issued a pamphlet "About Culverts," giving much valuable information about the use of vitrified clay pipe for culverts and side drains.

Bulletin A-5 of the Hydrated Lime Bureau, Pittsburg, Pa., is entitled "Modern Methods in Concrete Construction."

The Huber Mfg. Co., Marion, O., in a circular on new roads from old materials, describes the process of scarifying a macadam or gravel road, smoothing it and rolling it back into place, using their machinery in the processes.

The Galion Iron Works & Mfg. Co., Galion, O., are distributing an illustrated circular entitled "Galion Ideas Save Your Dollars," in which their cast iron and corrugated iron culverts, gravel screening plants, road drags, grading machines and scarifiers are shown.

Cressy Contracting Co. have a small circular illustrating their asphalt and oil sprayers for pressure distribution in road treatment of hot or cold bitumens of all grades.

About a year ago there appeared in several of the technical journals, an account of a test on a centrifugal pump installed at the Low Level Pumping Station of the City of Montreal, showing a duty considerably above any previously recorded for steam-turbine-driven centrifugal pumps. In answer to certain criticisms as to the method of figuring the duty, which was based upon the total heat taken by the turbine from the boiler, rather than the amount of steam used, and also regarding the omission of certain data from the test report, an article was prepared by A. Peterson, an engineer of the De Laval Steam Turbine Co., of Trenton, N. J., which the latter company has reprinted and is distributing in booklet form. The use of net B. t. u.'s as the basis upon which to calculate duty is defended upon the grounds that the user is interested in obtaining the most foot pounds from a given amount of heat, rather than the smallest weight of steam. It is shown that a heat cycle which may appear more efficient upon the basis of steam used, may at the same time be the less efficient upon the basis of heat used. Users of steam turbines will be interested in the detailed analysis of the turbine performance.

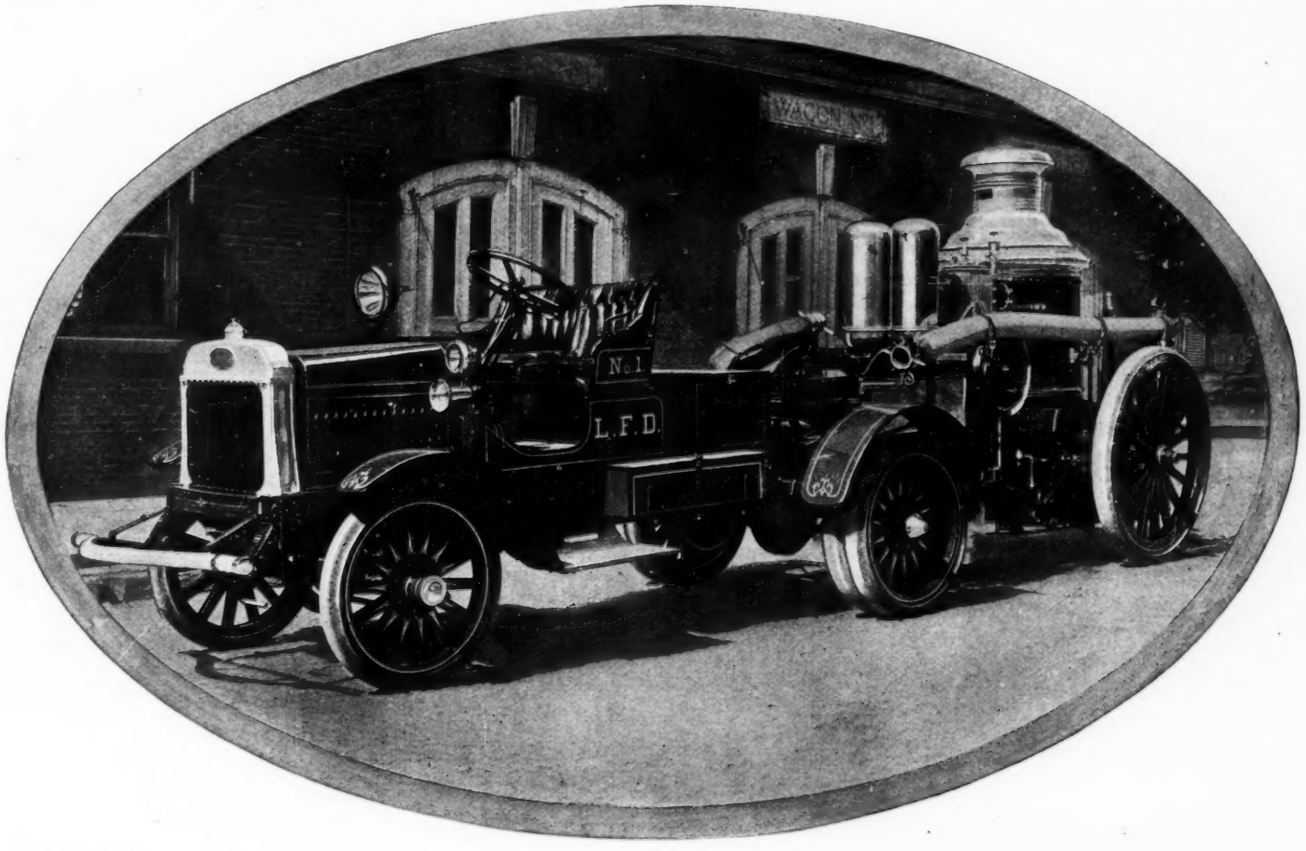
FIRE DEPARTMENT

Traction and Non-Skid Devices for Motor Fire Apparatus

Most fire chiefs have given the problem of securing traction on bad roads considerable thought and have personally tested or developed devices for overcoming their local difficulties. Conditions and ways of meeting them are, of course, largely governed by the geographical location of the city, but Olaf Johnson, fire chief for the city of Superior, Wis., has made some observations which should interest fellow chiefs wherever they may be.

"The Superior fire department," says Chief Johnson, "has to cover a territory of 47 sq. mi., much of which consists of clay streets that get into boggy condition after the heavy rains. Oftentimes these streets become practically impassable for heavy apparatus and the mud gets so deep as to make tractor for motor apparatus impossible.

"Under such conditions as these we have hesitated to add extra weight to our equipment. At the present time we have four pieces of motor apparatus in service, namely: one triple combination pumper, chemical and hose, in service nine months; one tractor for aerial truck, in service 2½ years; one auxiliary squad, in service nearly 5 years; and one chief's car, in service over 5 years. The only traction device we have used during these years is what is generally known as the Weed tire chains. We use these chains on all wheels during the winter, as we find it much easier to steer the apparatus when using chains on the front wheels. On the aerial truck we use heavy chains on the driving wheels, with cross chains reaching across the solid dual tires and a light center chain attached to each cross chain with a light ring and cold-shut. The function of the light center chain is to hold in place any cross chain which may break during a run so as to keep it



KISSEL KAR COMBINATION CHEMICAL AND SQUAD WAGON AS OPERATED BY MANY MIDDLE WESTERN MUNICIPALITIES.

from getting into the sprocket wheel or damaging the truck in any way. On the front wheels we use lighter chains, as they are not subjected to any strain.

"On our triple combination we use heavy chains on the outside units of the dual tires on the rear wheels for traction and lighter chains on the front wheels. The rear chains are kept on at all times, summer and winter, as we have to get off the pavements at times with this rig and must be prepared for it.

"However, I am satisfied that we cannot get along successfully and get traction under all conditions without chains reaching clear across the dual tires, and for that reason I have adopted the device gotten up by Chief Aungst of East Liverpool for use in addition to our other chains when road conditions are very bad. This device was introduced last year. It consists of several short chains, each long enough to go around the rim and tires of the wheels. A short piece of chemical hose is pulled over the chain to protect the rim and the ends of the chain are connected by a patent link, making it easy to put on and take off. If necessary, one of these chains may be put on for every spoke in the wheel.

"Our auxiliary squad is a comparatively light car with pneumatic tires, dual on rear wheels, and we use the same system or traction device on this car as we do on the triple combination, except that we use a lighter chain. On my own car the common Weed chains are used, both front and rear, when necessary. We inspect the chains frequently and replace the cross chains when they become worn so that they are apt to break.

"We buy a good grade of chain in bulk, cut them the right length and insert them ourselves when needed. For very bad road conditions I believe that the Aungst device is the best that has been brought to my attention.

"There have been other devices introduced and placed upon the market, but I have had no experience with them personally. Some of these devices are widely advertised as possessing great merit, which in many cases is testified to from seemingly reliable sources. We must not lose sight of this fact, that a device which might give satisfaction in your town may fail in mine, and a system which would answer the purposes in Ohio might not work successfully in Manitoba. Our city is perfectly level and our sister city, Duluth, is extremely hilly, so there you see my friend, Chief Randall, has a worse problem to solve than I have, tho the climatic conditions in both cities are the same. In summing up I might express my experience, as far as it goes, in this way: it takes chains under the tires to secure traction in snow and mud, and the deeper the snow and mud, the more chains it takes.

"It is safe to say that the builders of motor apparatus are furnishing plenty of power to take their machines thru all kinds of roads, if traction can be obtained, but they do not always furnish the best traction devices. I have seen some of the finest and most powerful apparatus sent out to places where road conditions are of the worst kind with driving wheels running so close that chains could not be used. The best machine is useless if it cannot be brought where it is needed, and manufacturers should give more thought to this important feature in developing the efficiency of their product.

"In connection with this subject I want to bring to your attention a device for raising the weight of the heavy apparatus off the tires. I believe we all feel that the constant pressure exerted upon the rubber by the heavy apparatus causes rapid deterioration and that this pressure should be relieved if possible.

"This contrivance is my own invention and you can have it made in your own repair shop for less than $3.00 for each set of wheels. It consists of a common jackscrew with a T-iron crossbar swinging free on a plate on the top of the jack and held in place by a link connection. The crossbar catches the axle at two points near the springs and by turning the screw the axle may be raised to release the pressure on the tires. With the brake set, it will stay in position, but as soon as the brake is released it will trip. It will not need to be removed, as the rear wheels cannot strike it and it requires little effort to operate. It can be used under front and rear wheels alike, as it can be made to fit any axle and conform to any height."

COUPLE-GEAR 3½ TON HOSE AND CHEMICAL (BATTERY-DRIVEN), AS OPERATED BY THE CITY OF SPRINGFIELD, MASS.

Motor Apparatus in Fire Departments

(Continued from May number, page 265. See April number for explanatory note.)

	Kind	Maker	Years Service	Cyl.	H.p.	Ft. Hose Carried	Gal. Chem. Carried	Ft. Ladder Carried	Mi. Trav. Last 12 Mo.	Alarms Last 12 Mo.	Cost of Repairs Last 12 Mo.	Cost Gas. and Oil Last 12 Mo.	Cost Maintenance Same Horse Equip.
Pennsylvania—													
Mt. Carmel	ch ho	Am.-La France	2	4	70	1,200	40	32	....	....	.....	.....	.....
	pp ho	Am.-La France	1	4	70	1,200	6	32	....	....	.....	.....	.....
Mt. Pleasant	ch ho	Am.-La France	1	4	70	1,200	40	32	....	....	.....	.....	.....
Munhall	ch ho l	White	6	4	30	750	50	180	100	31	.....	.....	.....
Nanticoke	ladd	Am.-La France	1	4	70	....	...	235	....	....	.....	.....	.....
New Castle	chf	Ford	3½	4	22	....	6	0	18,000	289	125.00	96.35	.....
	ch hc	White (2)	3½	4	45	1,200	40	36	291a	83a	75.50a	44.50a	540.00a
	pp ch ho	Knox	5	6	64	1,000	40	36	165	128	66.50	55.00	270.00
	pp ch hc	White	0	..	...	....	...	...	....	....	.....	.....	.....
New Kensington	ch ho	Hale	..	..	...	....	...	...	....	....	.....	.....	.....
Newville	pp ch ho	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Norristown	ch	Am.-La France	3	4	70	200	120	32	....	....	.....	.....	.....
Old Forge	pp ho	Am.-La Fr. (2)	2	6	100	1,200	6	32	....	....	.....	.....	.....
	pp	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Philadelphia	ladd	Webb	4	4	50	....	...	244 ..	....	3879a	.....	.....	.....
	ladd	Boyd (8)	½	4	67	....	...	244e	....	....	.....	.....	.....
	ladd	Seagrave (2)	2	4	80	....	...	244e	....	....	.....	.....	.....
	chf	White	4	6	60	....	...	...	....	....	.....	.....	.....
	chf	Cole (6)	4	4	45	....	...	...	....	....	.....	.....	.....
	chf	Ford (9)	1	4	22	....	...	...	....	....	.....	.....	.....
	ho ch	Alco	4	4	40	2,300e	...	...	....	....	.....	.....	.....
	ho ch	Mack (11)	5	4	50	2,300e	...	...	....	....	.....	.....	.....
	ho ch	Boyd (4)	5	4	50	2,300e	...	...	....	....	.....	.....	.....
	ho ch	Commer. (4)	2	L	13	2,300e	...	...	....	....	.....	.....	.....
	tr	Commer. (2)	3	L	13	1,250e	...	...	....	....	.....	.....	.....
	tr la	Webb	4	4	50	2,300	...	...	....	....	.....	.....	.....
	tr la	Knox-Martin	4	4	50	2,300	...	...	....	....	.....	.....	.....
	tr la	Commercial	2	L	13	2,300	...	...	....	....	.....	.....	.....
	tr la	Christie (4)	2	4	50	2,300e	...	...	....	....	.....	.....	.....
	tr la	Couple-Gear (2)	4	4	60	....	...	...	....	....	.....	.....	.....
	tr st	Webb	3	L	13	....	...	...	....	....	.....	.....	.....
	tr st	Boyd (11)	2	4	50	....	...	...	....	....	.....	.....	.....
	tr st	Commer. (3)	2	L	13	....	...	...	....	....	.....	.....	.....
	tr st	Couple-Gear	3	4	60	....	...	...	....	....	.....	.....	.....
	sup	Mack	3	4	50	....	...	...	....	....	.....	.....	.....
	sup	Peerless	10	4	40	....	...	...	....	....	.....	.....	.....
	sup	Knox-Martin	1	4	40	....	...	...	....	....	.....	.....	.....
Pittsburg	chf	Chalmers	1	4	...	....	...	...	....	....	.....	.....	.....
	chf	Overland (9)	2	4	29	....	...	...	....	....	.....	.....	.....
	ch ho	Am.-La Fr. (13)	4	4	70	1,200	70	32	....	....	.....	.....	.....
	tr	Am.-La Fr. (7)	1	4	70	....	...	...	....	....	.....	.....	.....
	tr st	Am.-La Fr. (8)	1	4	70	....	...	...	....	....	.....	.....	.....
	tr	Various (7)	2	4	90	....	...	...	....	....	.....	.....	.....
	ch ho	Hale	0	..	...	....	...	...	....	....	.....	.....	.....
	ch ho	Various (14)	4	4	48	1,000	40	36	....	....	.....	.....	.....
	ladd	Various (8)	4	4	48	....	...	...	....	....	.....	.....	.....
Port Carbon	ch ho	Waterous	..	..	...	....	...	...	....	....	.....	.....	.....
Pottstown	pp ho	Am.-La France	2	6	100	1,200	6	32	....	....	.....	.....	.....
Pottsville	chf	Stutz	3	4	90	....	35	...	100	11	200.00	5.00	.....
	pp ch ho	Robinson	6	6	...	1,250	...	80	....	....	.....	.....	.....
	ch ho	Knox	..	..	...	1,000	35	71	....	....	.....	.....	.....
	ch ho	Boyd	..	..	...	1,000	35	71	....	....	.....	.....	.....
	ch ho	White (2)	..	..	...	1,000	35	71	....	....	.....	.....	.....
	ch ho	Wonders	..	..	...	800	35	31	....	....	.....	.....	.....
Punxsutawney	pp ho	Am.-La France	2	6	100	1,200	6	32	....	....	.....	.....	.....
Rankin	ch ho l	Stegeman	1-12	6	50	1,200	40	36	33	41	.....	.....	.....
Reading	ch ho	Am.-La France	5	..	...	....	...	...	....	....	.....	.....	.....
	pp ho	Am.-La Fr. (2)	3	6	200	1,200	6	32	....	....	.....	.....	.....
	ae	Am.-La Rrance	½	4	70	....	...	...	....	....	.....	.....	.....
	ch ho	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
	st tr	Am.-La France	½	4	70	....	...	...	....	....	.....	.....	.....
	tr	Am.-La France	½	6	73	....	...	...	....	....	.....	.....	.....
Renovo	ch ho	Am.-La France	3	6	55	1,400	40	32	....	....	.....	.....	.....
Ridley Park	ch ho	Waterous	..	..	...	....	...	...	....	....	.....	.....	.....
Sayre	pp ho	Am.-La France	½	4	70	1,200	6	32	....	....	.....	.....	.....
Scranton	ch ho	Am.-La Fr. (3)	4	4	70	1,200	70	32	....	....	.....	.....	.....
	ae	Am.-La France	1	6	100	....	6	177	....	....	.....	.....	.....
	ladd	Am.-La France	1	4	70	....	...	235	....	....	.....	.....	.....
	ch ho	Am.-La France	1	..	...	....	...	...	....	....	.....	.....	.....
Sellersville	ch ho	Brockway	1	..	...	....	...	...	....	....	.....	.....	.....
Shamokin	ch ho	Am.-La France	2	6	100	1,200	70	32	....	....	.....	.....	.....
Shenandoah	ch ho	Am.-La France	½	4	75	1,000	75	45	....	....	.....	.....	.....
	pp ho ch	Boyd	2	6	90	1,200	120	45	....	12	.....	.....	.....
Somerset	ch ho	Am.-La France	2	4	70	1,200	70	32	....	....	.....	.....	.....
Spring City	pp ch ho	Am.-La France	½	6	100	1,200	40	32	....	....	.....	.....	.....
Susquehanna	ch ho	Brockway	1	4	42	1,400	40	32	....	....	.....	.....	.....
Swarthmore	ppg ho	Am.-La France	3	6	100	1,200	6	32	....	....	.....	.....	.....
Taylor	ch ho l	Brockway	2	4	40	1,000	50	16	30	15	0	.....	.....
Trainer	pp ch ho	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Uniontown	ch ho	Knox	1	4	70	2,000	70	72	80	72	25.00	90.00	730.00
Warren	ch ho	Am.-La France	4	4	70	1,200	70	32	....	....	.....	.....	.....
Waynesboro	ladd	Am.-La France	½	4	70	....	...	235	....	....	.....	.....	.....
West Chester	pp ho	Am.-La France	3	6	100	1,200	6	32	....	....	.....	.....	.....
Wilkes-Barre	chf	Stutz	1	4	36	....	6	...	2,000	260	.....	.....	.....
	pp ho	Am.-La France	3	6	82	1,200	...	48	800	....	.....	.....	.....
	ch ho	(8)	8	4	50	1,200	35	50	4,000	....	.....	.....	.....
	pp st	(2)	3	4	90	....	...	...	500	....	.....	.....	.....
	tr	(4)	3	4	90	....	...	...	1,000	....	.....	.....	.....
Wilkinsburg	ch ho	Am.-La France	4	4	70	1,200	70	32	....	....	.....	.....	.....
Williamsport	pp ho	Am.-La France	2	6	100	1,200	6	32	....	....	.....	.....	.....
Williamstown	ch ho	Am.-La France	1	..	...	....	...	...	....	....	.....	.....	.....
Windber	ch ho	Seagrave	3	6	90	1,400	75	32	100	30	250.00	.....	.....
	ladd	Mitchell	16	6	70	....	...	130	100	30	75.00	.....	.....
Woodlawn	ch ho	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Rhode Island—													
Central Falls		Has no motor apparatus at present.											
East Providence	ch ho l	Alco	5	6	60	1,000	50	54	253	96	526.15	35.00	.....
Newport	chf	Overland	..	..	...	....	...	...	....	....	.....	.....	.....
	ch ho	Am.-La Fr. (4)	3	4	70	1,200	40	32	....	....	.....	.....	.....
	pp ho	Am.-La Fr. (3)	1	6	100	1,200	6	32	....	....	.....	.....	.....
	ladd	Am.-La Fr. (2)	1	4	70	....	...	235	....	....	.....	.....	.....
	st	Two in reserve drawn by motor.											

	Kind	Maker	Years Service	Cyl.	H.p.	Ft. Hose Carried	Gal. Chem. Carried	Ft. Ladder Carried	Mi. Trav. Last 12 Mo.	Alarms Last 12 Mo.	Cost of Repairs Last 12 Mo.	Cost Gas. and Oil Last 12 Mo.	Cost Maintenance Same Horse Equip.
Providence	ch ho	Am.-La France	2	4	70	1,200	40	32	....	....	.....	.....	.....
	sal	Am.-La France	5	..	...	....	...	...	....	....	.....	.....	.....
	pp ho	Am.-La Fr. (5)	½	6	100	1,200	6	32	....	....	.....	.....	.....
	ae	Am.-La France	½	4	70	....	...	...	....	....	.....	.....	.....
	ladd	Am.-La Fr. (2)	½	4	70	....	...	235	....	....	.....	.....	.....
	tr	Am.-La France	½	6	73	....	...	...	....	....	.....	.....	.....
Warren	ch ho	Am.-La France	1	..	...	....	...	...	....	....	.....	.....	.....
Woonsocket	chf	Rambler	3½	4	32	....	6	...	5,500	312	.....	.....	.....
	ch ho	Pope-Hart. (2)	3	4	50	1,000	46	32	....	....	.....	.....	.....
		Knox (1)	3	4	50	1,000	46	32	....	....	.....	.....	.....
	ladd	Seagrave	3	4	90	....	...	350	....	....	.....	.....	.....
South Carolina—													
Aiken	ch ho	Am.-La France	3	4	70	1,200	40	32	....	....	.....	.....	.....
Anderson	ch ho	Am.-La France	4	4	70	1,200	40	32	....	....	.....	.....	.....
Columbia	chf	White	5-6	4	35	....	40	...	....	200	28.00	16.00	.....
	ch ho	Am.-La France	5	4	70	1,000	46	30	485	425	84.40	33.90	.....
	pp ho	Am.-La France	2	6	120	1,200	6	32	363	221	134.10	92.00	.....
	ae	Seagrave	2	6	80	....	6	255	347	225	187.60	40.80	.....
	pp ho	Robinson	2	6	110	1,750	6	30	236	200	143.25	80.80	.....
	pp ho	Webb	..	6	72	1,750	6	30	247	142	127.00	79.50	.....
Gaffney	ch ho	Am.-La France	4	4	70	1,200	40	32	....	....	.....	.....	.....
Georgetown	pp	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Greenville	ch ho	Am.-La France	1	6	100	1,400	40	32	....	....	.....	.....	.....
Laurens	pp ho	Am.-La France	1	4	70	1,200	6	32	....	....	.....	.....	.....
Manning	ch ho	Am.-La France	1	6	55	1,400	40	32	....	....	.....	.....	.....
Orangeburg	ch ho	Am.-La France	4	4	70	1,200	40	32	....	....	.....	.....	.....
Rock Hill	pp ch ho	Am.-La France	4	6	95	1,000	46	36	190	....	6.00	100.83	489.40
Spartanburg	pp ho	Am.-La France	4	6	100	1,200	6	32	....	....	.....	.....	.....
Union	ch ho	Am.-La France	3	4	70	1,200	40	32	....	....	.....	.....	.....
South Dakota—													
Aberdeen	chf	Studebaker	1-12	6	40	350	25	...	100	1	.....	10.00	.....
	ch ho	White	2	6	80	1,200	40	40	200	66	23.00	60.00	264.00
Sioux Falls	ladd	Am.-La France	1	4	70	....	...	235	....	....	.....	.....	.....
	ch ho	Am.-La France	1	6	100	1,200	6	32	....	....	.....	.....	.....
Tennessee—													
Bristol	ch ho	Am.-La France	3	4	75	1,200	40	32	....	....	.....	.....	.....
Chattanooga	ho	Am.-La France	1	6	75	1,000	6	32	289	92	6.00	41.80	.....
	tr st	Am.-La France	1	6	75	....	...	...	165	43	1.45	27.33	.....
	pp ho l	Am.-La France	2-3	6	70	1,000	40	32	193	91	14.91	66.25	.....
	pp ho l	Am.-La France	1	6	70	1,000	40	32	244	119	77.84	51.41	.....
	pp ho l	Am.-La France	¾	6	70	1,000	40	32	306	65	2.50	76.54	.....
	pp ho l	Webb	..	..	...	....	...	...	158	27	394.28	32.95	.....
	pp ho l	Am.-La France	..	6	70	1,000	40	32	46	181	25.50	89.07	.....
	pp ho l	Am.-La France	..	6	70	1,000	40	32	594	175	5.56	140.42	.....
	pp ho l	Am.-La France	..	6	70	1,000	40	32	692	91	22.05	85.20	.....
	ch	Am.-La France	..	4	45	....	105	32	1,398	333	98.05	97.30	.....
	ae	Am.-La France	..	6	100	....	6	...	351	124	6.55	64.07	.....
	sup	(1)	..	..	...	....	...	...	....	....	.....	.....	.....
	chf	(3)	..	..	...	....	...	...	....	....	.....	.....	.....
Clarksville	pp ho	Am.-La France	3	6	100	1,200	45	40	900	35	10.00	.....	.....
Cleveland	pp	Am.-La France	1	..	...	....	...	...	....	....	.....	.....	.....
Columbia	pp ho	Am.-La France	3	6	100	1,200	6	32	....	....	.....	.....	.....
Humboldt	ch ho	Am.-La France	1	..	...	....	...	...	....	....	.....	.....	.....
Jackson	pp ho	Am.-La France	4	6	100	1,200	6	32	....	....	.....	.....	.....
Johnson City	pp ho ch	Am.-La France	2½	4	110	1,000	54	24	154	63	3.50	74.00	.....
Knoxville	pp ho	Am.-La France	2	6	100	1,200	6	32	....	....	.....	.....	.....
	pp	Am.-La France	1	..	...	....	...	...	....	....	.....	.....	.....
Memphis	sal	Am.-La France	5	..	...	....	...	...	....	....	.....	.....	.....
	pp ho	Am.-La Fr. (2)	4	6	100	1,200	6	32	....	....	.....	.....	.....
	ladd	Am.-La France	3	4	70	....	...	235	....	....	.....	.....	.....
	sal	Am.-La France	2	4	70	....	...	...	....	....	.....	.....	.....
	pp	Am.-La Fr. (2)	½	..	...	....	...	...	....	....	.....	.....	.....
Morristown	pp	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Mt. Pleasant	ch ho	Am.-La France	1	6	100	1,200	40	32	....	....	.....	.....	.....
Murfreesboro	ch ho	Am.-La France	½	6	100	1,200	40	32	....	....	.....	.....	.....
Nashville	chf	Marathon	6	..	35	....	4	...	....	....	.....	120.00	.....
	pp ho	Am.-La Fr. (6)	4	6	100	900	35	30	705	137	210.00	51.91	597.32
	tr	Am.-La France	2	6	100	....	6	200	231	150	3.00	43.00	450.00
Paris	ch ho	Am.-La France	2	4	70	1,200	40	32	....	....	.....	.....	.....
Park City	pp ho	Am.-La France	4	4	70	1,200	6	32	....	....	.....	.....	.....
Shelbyville	pp ch ho	Am.-La France	½	6	55	1,400	40	32	....	....	.....	.....	.....
Union City	ch ho	Am.-La France	½	4	70	1,200	40	32	....	....	.....	.....	.....
Texas—													
Abilene	pp ho ch	Am.-La France	3	4	75	1,200	35	32	....	94	3.40	100.25	396.00
Amarillo	chf	Staver	1	4	60	....	...	...	879	....	0	26.00	.....
	ch ho l	Am.-La France	5	4	76	1,200	35	28	24	79	0	.....	.....
	pp ho	Am.-La France	2	6	105	1,200	...	32	232	79	0	.....	.....
	ch ho l	Cadillac	3½	4	40	850	35	28	315	79	0	101.00a	.....
Austin	chf	Ford	..	..	...	....	...	...	5,000	....	.....	.....	.....
Ballinger	pp ho	Am.-La France	½	4	70	1,000	6	32	....	....	.....	.....	.....
Bastrop	ch ho	Brockway	1	4	30	200	30	26	....	....	.....	.....	.....
Beaumont	chf	White	3	..	40	....	...	...	....	198	2.25	.....	.....
	ch ho	Am.-La France	3	..	72	1,200	35	32	....	198	1,785.00	.....	.....
	pp ho	Ahrens-Fox	2	..	80	1,200	...	34	....	104	.....	.....	.....
Belton	ch ho	Am.-La France	3	4	70	1,200	40	32	....	....	.....	.....	.....
Bonham	ch ho	Am.-La France	3	4	70	1,200	46	32	....	....	.....	.....	.....
Brady	pp ho	Am.-La France	2	6	100	1,200	6	32	....	....	.....	.....	.....
Bryan	ch ho	Am.-La France	4	4	70	1,200	40	32	....	....	.....	.....	.....
Cameron	pp ho	Am.-La France	½	4	70	1,000	6	32	....	....	.....	.....	.....
Cisco	ch ho	Brockway	1	4	42	1,400	40	32	....	....	.....	.....	.....
Cleburn	ch ho	Am.-La France	1	6	55	1,400	40	32	....	....	.....	.....	.....
	ladd	Am.-La France	1	6	55	....	...	235	....	....	.....	.....	.....
Coleman	pp ch ho	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....
Colorado	ch ho	Brockway	1	4	42	1,400	40	32	....	....	.....	.....	.....
Cooper	pp ho	Am.-La France	3	4	70	1,000	6	32	....	....	.....	.....	.....
Corpus Christi	pp ho	Am.-La Fr. (2)	3	6	100	1,200	6	32	....	....	.....	.....	.....
Corsicana	pp ho	Am.-La France	3	6	100	1,200	6	32	....	....	.....	.....	.....
Dallas	chf	Cadillac	1	..	...	....	...	6	....	....	.....	.....	.....
	chf	Cadillac	½	..	...	....	...	40	....	....	.....	.....	.....
	chf	Stud., Garford	5	..	...	....	...	40	....	....	.....	.....	.....
	chf	Studebaker	5	..	...	....	...	40	....	....	.....	.....	.....
	pp ho	Am.-La France	3	6	100	1,200	6	32	....	....	.....	.....	.....
	pp ho	Am.-La France	2	6	100	1,400	40	32	....	....	.....	.....	.....
	ch ho	Am.-La Fr. (2)	3	6	200	1,200	6	32	....	....	.....	.....	.....
	pp ho	Webb (3)	5	..	...	....	...	...	....	....	.....	.....	.....
	ladd	Webb	4	..	...	....	...	...	....	....	.....	.....	.....
	pp ho	Am.-La France	½	..	...	....	...	...	....	....	.....	.....	.....

Contracting News

AUTOMOBILES, FIRE APPARATUS AND MOTOR EQUIPMENT.

Bristol, Conn.—Board of Fire Commissioners will commence negotiations at once for purpose of securing prices and providing demonstrations of fire engine.

Chamberlin, S. D.—Residents of Pukwana Township, Brule County, voted to purchase traction engines and graders for purpose maintaining good roads.

Cincinnati, O.—Planning for purchase of 15 units of automobile fire fighting apparatus. Purchase made available thru receipt of $127,000. Fire Chief Houston. Three tractors, two service trucks, one aerial truck, one combination hose wagon, chemical and life saving apparatus, four 1,000-gal. combination pumpers, 4 800-gal. combination pumpers.

Columbus, O.—Ordinance appropriating $1,000 for purchase auto truck to supplant service of two horses and wagons in waterworks department. Will have favorable report at council meeting.

Cleveland, O.—City Board of Control authorized purchase steam roller and two trucks to be used in road improvement.

Greenfield, O.—Ordinance passed to issue $7,000 bonds for purpose paying cost and expenses of purchase motor fire truck and necessary equipments. E. M. Conner, Village Clerk.

Louisville, O.—Agitation for purchase of light auto fire engine is being made by the business men of town.

Mt. Gilead, O.—County Commissioners negotiating for purchase another automobile truck of 5 tons to assist in road construction work.

New York, N. Y.—Resolved that Fire Commissioner is authorized and empowered to purchase five gasoline pumping engines, five hook and ladder trucks, fifteen tractors and ten hose wagons. Total cost not to exceed $194,500.

Schuylkill, Pa.—Boyerstown Council passed an ordinance for purchase $9,000 auto apparatus for Friendship Hook & Ladder Co.

Stevens Point, Wis.—City Council authorized purchase fire automobile truck, $5,600.

Weehawken, N. J.—West New York Town Council authorized bond issue of $30,000 for purchase of motor-driven fire equipment, including two combination pumping engines, 1,000-gal. capacity, and one hose tender. Bids will soon be asked.

BRIDGES.

BIDS REQUESTED.

Bedford, Ind.—June 23, 1 p. m., Lawrence County Commissioners, for unfinished work on Salt Creek bridge in Shawswick Township. E. W. Edwards, Auditor.

Crookston, Minn.—June 12, 10 a. m., County Board of Polk County, bridge steel and concrete 23-ft. span, section 34-35, Russia Township; bridge steel and concrete 23-ft. span, section 30-31, Argus Township; bridge steel and concrete 30-ft. span, section 27-28, Tabor Township; bridge steel and concrete 18-ft. span, section 4-9, Tabor Township. Plans and specifications on file office County Auditor and office E. H. Harding, City Engineer. H. J. Welte, County Auditor.

Ellendale, N. D.—June 20, 2 p. m., Board of County Commissioners of Lamoure and Dickie Counties for furnishing materials and building bridge single span 18-ft. long, one beam steel, concrete floor. Piles to be 24-ft. long, imbedded in concrete. C. C. 5 per cent. Address C. C. Misfeldt, County Auditor.

Fairfax, Minn.—June 8, 2 p. m., County Boards of Renville and Browns Counties, Village Hall, building state bridge across Minnesota river. Plans and specifications State Highway Commissioner, St. Paul, and County Auditors. C. C. 10 per cent. Louis G. Vogel, County Auditor, Brown County; J. L. Johnson, County Auditor, Renville.

LaMoure, N. D.—June 19, 2 p. m., Board of County Commissioners, LaMoure County, for furnishing materials and building four bridges according plans and specifications on file office of County Auditor. One bridge built on section line between Sections 20 and 21, 20-ft. steel span, concrete floor, or, a 12-ft. steel span, concrete floor, or, a 12-ft. concrete slab floor resting on five steel piles at each end. One bridge on section line between Sections 26 and 27, 1 12-ft. steel span, concrete floor, or, a 12-ft. steel span, concrete slab floor. One bridge on section line between Sections 17 and 18, 1 20-ft. steel span, concrete floor, or, a concrete slab floor. One bridge on section line between Sections 35 and 36; 1 16-ft. steel span with plank floor or concrete slab floor. C. C. 5 per cent. O. C. Temple, County Auditor.

Mohall, N. D.—June 12, 2 p. m., Renville County Board of County Commissioners, construction three stone bridges according specifications on file. C. C. 5 per cent. R. D. Johnson, chairman Peter Carlson Co., Auditor.

Valley City, N. D.—June 11, 2 p. m., County Commissioners, constructing bridge according plans and specifications. C. W. Nelson, County Auditor.

CONTRACTS AWARDED.

Albany, N. Y.—W. S. Rae, Pittsburgh, Pa., has contract for rebuilding two spans, Alplaus bridge over Mohawk river and barge canal.

Bethlehem, Pa.—Contract construction temporary bridge over Lehigh river was awarded to Horsehead Construction Co., Horsehead, N. Y., at $24,000.

Elizabeth, N. J.—Board of Free Holders let contract for new bridge, Eastman St., Conford, to Dover Boiler Works, Dover, N. J., at $19,000.

Franklin, Ky.—Contract for constructing a bridge over Red river on Springfield road was awarded Virginia Bridge and Iron Co., Roanoke, Va., at $11,000.

Kansas City, Mo.—Contract for constructing bridge over Blue river, at Leads, was awarded by Board Public Works to N. Miller, 3112 Highland St., at $37,033.

Linton, N. D.—Linton Bridge Construction Co. awarded contract construction of 50-ft. span steel bridge, with 18-ft. roadway, located between Sections 9 and 10.

Martinsburg, W. Va.—Thomas Sheehan, Hagerstown, Md., lowest bidder for erecting of sub-structure for Kentucky Memorial Bridge, which will span the Potomac river. Total cost, $1,000,000.

Newton, N. C.—Contract for constructing the horse ford bridge over Calawaha river, between Calawaha and Caldwell Counties, was awarded to C. W. Requarth Co., Charlotte County, at $38,000.

Paterson, N. J.—Board of Freeholders awarded contract for reinforced concrete arch bridge over Passaic river, Singac, Pompton-Newark Turnpike, to Logan Construction Co., 13 Park Row, New York, at $63,500.

Richmond, Ind.—Isaac E. Smith, Richmond, awarded contract by Board of County Commissioners for constructing Main St. bridge, across Whitewater river, at bid of $169,990.

Seattle, Wash.—Board Public Works awarded J. A. McEachran, local contract for constructing wooden draw bridge at $61,606.49. Cost of steel to be added, total cost, $70,000.

Seattle, Wash.—Contract for constructing a 1,705-ft. pile trestle over north end of Loke Washington was awarded to C. Geske & Co., Pacific Blk., at $12,354.

CONTEMPLATED WORK.

Albany, N. Y.—Assembly passed bill appropriating $225,000 for constructing bridge across Mohawk river, between Crescent and Rexford, near Schenectady.

Brookville. Ind.—July 2, 1 p. m., Franklin County Auditor, $28,000 bridge bonds, 4 per cent., 5 years. Chas. G. Reifel, Auditor.

Duluth, Minn.—Ordinance providing issuance $50,000 of bonds for repairing, reconstructing and filling of bridges at Oneota St. and Forty-third Ave., Sixty-fifth Ave., North, and Grand Ave., Woodland Ave., and St. Marie St., and Tenth St. and Fifth Ave., East, in City of Duluth.

Elgin, Ill.—Definite plans for new bridge across the river at Kimball St., to come within $60,000, were submitted by two bridge engineers.

Ft. Wayne, Ind.—An appropriation of $20,000, approved by Allen County Council, for construction of proposed bridge.

Milwaukee, Wis.—Department Public Works plans construction of reinforced concrete bridge, 1,553 ft. long, 40-ft. roadway, on North Ave. Estimated cost, $400,000.

Reading, Pa.—Carpenter Steel Works having plans made for reinforced concrete bridge at its works, to cost about $65,000. Wm. H. Dechart & Son, Baer Building, Engineers.

PAVING.

BIDS REQUESTED.

Bluffton, Ind.—June 6, 2 p. m., Commrs. Wells Co., const. 2 stone sts. 2,228 and 1,334.5 ft. in length; also stone rd. in Lancater twp. 6,485 ft. in length. C. F. Kain, Auditor.

Corydon, Ind.—June 7, 1 p. m., Commrs. Harrison Co., constr. rock roads in Harrison and Morgan twps. Sam C. Mauch, Auditor.

Dayton, O.—June 14, Bd. of Commrs. of Montgomery Co. will receive bids for paving Wolf Creek Pike with brick to a length of 2 mi. Plans on file. C. C. $1500. Walter H. Asling, Clerk.

Elbow Lake, Minn.—June 18, 2 p. m., Office Co. Audr. of Grant Co., constr. of job No. 1704, St. Road No. 9, as follows: Excavation, 27,210 cu. yds., $8,103; borrow, 4,100 cu. yds., $820; turnpike, 18,015 cu. yds., $1,260. Estimated total cost, $9,243. Plans and specifications with County Auditor, or Office Hwy. Commission, St. Paul. C. C. 5 per cent. C. N. Nelson, County Auditor.

Harrisburg, Pa.—June 12, 10 a. m., St. Hwy. Dept. will receive bids for vitrified block or reinforced concrete paving (about 3* lin. ft.) in Cecil and Strabine Twps., Washington Co., and S. Faye Twp., Allegheny Co. Frank B. Black, Hwy. Commr.

Hattiesburg, Miss.—Bd. of Cuprvs. receive bids for constr. 46 mi. of rds. in Forrest Co. Estimated cost $81,694.10. Engr., F. Myers.

Lafayette, Ind.—June 6, 10 a. m., Commrs. of Tippecanoe Co., constr. 2 gravel rds. in Wayne Twp. 2.01 and 1.39 mi. in length. George W. Baxter, Auditor.

Laporte, Ind.—June 7, 10 a. m., Commrs. Laporte Co., constr. rds. in Center and New Durham Twps. Fred A. Hansheer, Auditor.

Lebanon, O.—June 12, Clerk of Village receives bids constr. concrete combination curb and gutters on both sides of Orchard Ave. Plans with City Engineer. C. C. $100. M. E. Gustin, Clerk; Roy E. Miller, Cy. Engr.

Minneapolis, Minn.—June 12, 11 a. m., Office Co. Auditor, bids will be received for grading and surfacing 96,186 lin. ft. of roads No. 4 and 38 in towns of Minnetonka and Eden Prairie, according to plans and specifications. C. C. 5 per cent. A. P. Erickson, County Auditor.

Montgomery, Ala.—June 6, 12 m., Baldwin Co. Commrs., at Court House, Bay Minette, Ala., constr. grading and otherwise improv. public hwy. from Robertsdale, Ala., to Munnez Ferry, Ala. 18 mi. long. Specif. J. M. Garrett, Engr. C. C. $500. L. Glendinning, Commrs.

Peru, Ind.—June 11, 12 m., Commrs. Miami Co., constr. rd. in Jefferson Twp. and one on line Clay and Harrison Twps. Frank H. McElheny, Adr.

Thief River Falls, Minn.—June 12, 8 p. m., City Council, constr. of concrete sidewalks and st. crossings according to plans and specif. A. H. Facial, City Clerk.

Yankton, S. D.—June 11, 9 a. m., for furnishing all tools and labor and materials to pave alley running east and west to the west half of block 25. Plans and specif. office City Audr. C. C. $100. John W. Summer, City Auditor.

CONTRACTS AWARDED.

Aberdeen, Wash.—Bids for paving Hume and Michigan Sts. were received from: Grays Harbon Constr. Co., Hoquiam, Wash., asphalt, $12,211.40, asphaltic concrete, $12,314.60; Hankle-Hegg & Co., Aberdeen, Wash., asphalt, $12,611.00, concrete, $11,435.70.

Akron, O.—The Peters Carpenters Handy Co. have contract paving North Howard st. extension at their bid of $74,466. Contract for aqueduct, Weber and Charlottte Sts., was awarded to Charles H. Waters, Akron, for brick pavement and grout filler and stone curb at $26,000.

Contracting News

Albany, N. Y.—Dale Engr. Co., Utica, only bidder imprvt. Barners Corners, West Lowville Rd., part 1, in Lewis Co. Road is 5.37 mi.; bid., $57,940.

Auburn, Cal.—The Tibbits Pacific Co., San Francisco, awarded contract by city Trustees for paving business sts. for $40,-891.15.

Bayfield, Wis.—Contract for paving 7 blocks has been let by City Council to Sweeney Bros., Reedsburg, Wis. Material, vitrified brick on sand foundation with asphalt binding. Work will cost $1.85 per sq. ft. for paving, 50c per lin. ft. for gutter and 45c per cu. yd. for excavations.

Brazil, Ind.—Co. Commrs. of Clay Co. awarded contract for constr. stone road on line between Perry and Posey Twps. to Campbell & Hawkins, at $16,448.

Brookhaven, Miss.—Contract for constr. 19.7 mi. rd. Dist. No. 4, was awarded by Bd. of Suprvs. of Linton Co., to Middleton & Smith, at about $37,941.

Burlington, Ia.—City Council awarded contract for paving and grading High St., Main to 4th, to Burlington Constr. Co., $2.06 sq. yd.

Chicago, Ill.—Contract imprv. of 18½ mi. Higgins road awarded Commonwealth Improvement Co., Denver, Colo., for $448,000.

Chicago, Ill.—Joseph Plasey & Co. low bidders on east section of Dundee Rd. at $70,946.01; Andrew Ward & Sons, Oak Glen, Ill., west section, at $94,399.33.

Cincinnati, O.—Bd. of Control awarded contract for widening the intersection of Linwood and Eastern Aves. to Kirschner Constr. Co., Cincinnati, at its bid of $30,000.

Danville, Ind.—Co. Commrs. Hendricks Co. awarded contract constr. rd. in Washington Twp. to Hurst, Sweet & Co., Coatesville, at $20,000.

Dayton, O.—Ed. Ryan, Springfield, only bidder, paving Third St. from Perry St. west to River, and from Wyandotte St. east to the railroad. Estimated bids will approx. $40,000 on this job.

Decatur, Ill.—State Highway Commr. awarded William G. Amman, Decatur, contract constr. state aid highway between Macon and Blue Mound, a distance of 27,-000 ft., his bid being $10,322.55. Other bidders were: Stewart & Fluff, Oreana, $10,-573.44; A. O. McCoy, Varsailles, $11,236.09; Duis & Olson, St. Joseph, Mo., $11,179.08; Hendricks & McGary, Decatur, $11,090; Cameron Joyce & Co., Keokuk, $10,917.26.

Des Arc, Ark.—P. F. Connelly Pav. Co., Little Rock, Ark., has contract 5½ mi. concrete sidewalk.

Dubuque, Ia.—C. B. McNamara Co., local, awarded brick paving contract, $95,000.

Fargo, N. D.—C. T. Welch & Co., Minneapolis, were awarded contract by the City Council for paving on 8th St. and 7th Ave., souts. Bituminous concrete will be used and total cost will be $37,995.

Frankfort, Ind.—Bids were received for improvements of East Morrison and Sims Sts., as follows: Patton & Son, Veedersburg, $15,167; A. F. Cohes, $15,769; W. J. Nees & Co., $15,630.50.

Galion, O.—Forest Constr. Co., Galion, has contract building the Olivesburg Road, a distance of 1½ mi., at their bid, $29,000. Road will be a 14-ft. tar-bound macadam.

Greenville, O.—Bd. of Control awarded contract, paving of Washington Ave., to John M. Manix, local contr., at $19,347.18.

Greenville, O.—Nine bids were received for improvt. Vine and Sweitzer Sts., by paving: Sweitzer St., Karch & White, Celina, $29,686.73; J. W. Heffner & Son, Celina, $33,385.09; John H. Manix, Greenville, $32,643.43. Vine St., Karch & White, $14,-522.44; John H. Manix, $15,200.97; McHugh Bros., Springfield, $16,041.10; Heffner & Son, $15,525.63; S. A. Warner, Greenville, $17,330.10.

Hartford, Conn.—Edw. Balf Co. awarded contracts for paving portions of Albany Ave. and Windsor, $27,512.00; portions of Capitol Ave., Ann, Ferry, North and Kilburn Sts., $28,911.90.

Idaho Falls, Idaho—J. C. Maguire, Butte, Mont., awarded contract paving Water Ave., gravel bitulithic 6 in. in thickness, at $1.70 per yard and 50c per ft. for curbing. Total, $27,673.64.

Jefferson, O.—Contract for paving with brick of Dorset-Cherry Valley Rd. was awarded T. P. Fitgzerald, Ashtabula, at $63,890.80.

Jersey City, N. J.—Bd. Freeholders let contract to Wm. J. Coughlin, 665 Newark Ave., Jerseyl City, for paving Newark turnpike at $547,857.

Los Angeles, Cal.—Brashaer-Burns Co., Los Angeles, lowest bidders at $28,093.30 for 4.1 mi. concrete paving on state hwy. in Los Angeles Co., between Castiac and Castiao School. Work involves 23,100 cu. yds. of excavation, mixing and laying 3,-950 cu. yds. of concrete in pavement, building concrete and corrugated metal culverts and guard rails.

Marion, O.—Bd. of Control awarded contract for paving of 5 sts. to H. T. Striecher Co., Toledo, with sheet asphalt, at their bid approx. $53,000.

Marshalltown, Ia.—Bd. of Supvr. awarded Tim Ryan, Loveland-Marietta rd., city limits in Summit St. to Marietta, 4½ mi.; estimated grading 28,473 cu. yds. at 21c per cu. yd. ;estimated graveling 4.260 cu. yds. at 50c per yd.; Wm. Cox, Vinton, 3½ mi., estimated grading 30,029 cu. yds. at 23.5c per cu. yd.; P. E. Shugart, Nevada, 1 mi., estimated grading 17,763 cu. yds. at 27c per cu. yd.; Morrison Construction Co., Des Moines, 1 mi., estimated grading 25,-833 cu. yds. at 24.7 c per cu. yd.

Mason City, Ia.—Contract was let to P. E. Sugart, Nevada, for approx. 54,000 cu. yds. in all, making contract price nearly $13,000.

Monticello, Ind.—Co. Commrs. of White Co. awarded contract constr. rd. to G. A. Killenburger, Reynolds, at $16,500.

Morris, Minn.—Contract for paving several streets was awarded S. Loher, Chokio, at $13,331.00.

North Chicago, Ill.—Contract for paving 10th St. was awarded by Bd. of Local Improvements to C. P. Moran, Waukegan, at $15,736.

Ottawa, Ill.—Joseph J. Leix, Ottawa, awarded two paving contracts by the city. Bids as submitted for Forest St., Joseph Leix, Ottawa, $6,933.40; F. E. Ball, Ottawa, $7,616.44; T. W. Keys, LaSalle, $7,983.42; Johnson & Schafer, Pekin, $8,009.76. Lafayette St., Joseph Leix, Ottawa, $21,-660.15; F. E. Ball, $23,169.87; Johnson & Schafer, $24,589.38; T. W. Keys, $24,691.24.

Peru, Ind.—Co. Commrs. of Miami Co. awarded contract for constr. Jacob Moore Rd. No. 8 in Pipe Creek Twp. to John L. Miller & Co., Bunker Hill, at $12,497.

Rochester, Ind.—Contract constr. stone rd. was awarded by Co. Commrs. of Fulton Co. to E. J. Williams, Macey, at $16,387.

Rochester, N. Y.—Thomas Holahan, local, low bidder Genesee Park Blvd., $98,000; Ribstein & Holter, local, low bidders on Orange St. pavements.

Roundup, Mont.—Contract awarded Warren Constr. Co., Portland, Ore., at $75,389 as next lowest bidder when G. H. Nash, Missoula, withdrew his bid of $71,427.50.

Spencer, Ind.—Contract for const. of crushed stone road was awarded by Co. Commrs. of Owen Co. to L. P. Hays, Worthington, at $11,000.

Springfield, Ill.—Contracts for state aid road work were awarded by State Highway Commr. as follows: Earth rd. in Massac Co. to Quincy Martin, Metropolis, at $1,-539; village earth rd. in Jersey Co., to Edw. Connors, Jerseyville, at $4,871; earth road in Marshall Co. to D. M. Dean, Lacon, at $11,986.

Toledo, O.—County Commrs. awarded contracts to: M. T. Nannon, 4 mi. Saeman road at $43,345; Phil Garygon & Son, Toledo, ½ mi. Tank Rd. at $15,734; Doan & Langerderger, 2 mi. Davis Rd. at $21,868.

Topeka, Kans.—City Commrs. awarded Ritchie Bros., Kansas City, contract paving 9 blocks with brick, $32,547.43.

Tottenville (Staten I.), N. Y.—Uvalde Asphalt Paving Co., 1 Broadway, New York, awarded contract for paving sec. No. 2 of Amboy Rd. from Tottenville to New Dorp, at about $100,000.

Trenton, N. J.—Contract for repairing Greenwood Ave. and Lawrence Rd. was awarded by Bd. of Freeholders of Mercer Co. to C. A. Reed & Co., 623 Monmouth St., at $10,921.

Vincennes, Ind.—Bd. of Co. Commrs. gave contracts for constr. of the Joseph Miller and Otto Kraemer brick roads to the S. R. Adams Co., of Princeton. Miller road will cost $41,318; Kraemer Road, $52,-929. Both roads are about 2½ mi. long.

Warren, O.—Contract for the Youngstown-Kingsville Rd. has been awarded to Gustavus Constr. Co., at their bid of $14,481.

Wenatchee, Wash.—Commrs. awarded C. M. Payne, contractor of Spokane, contract for paving with concrete 1.25 mi. rd. this side of Monitor on the Wenatchee-Cashmere Hwy. Bid $19,631 for 18-ft. pavement.

Yonkers, N. Y.—St. Hwy. Comm. received following proposals for work on Tuckhoe and White Plains Rds., 2.74 mi.; James McAvoy, New York City, $67,809.60; Wilkes-Cassey Co., New Rochelle, $80,-303.10.

Yonkers, N. Y.—St. Commrs. Hwy. reports following proposals for rd. constr., repairs in West Chester Co. Rd 503, Granite Contracting Co., Inc., Cohoes, $36,387; Lewis Petrillo, Mt. Vernon, $36,406; Daly & Merritt, Inc., Pt. Chester, $37,485.

Sacramento, Cal.—The following proposals were received by St. Hwy. Commrs. Highway Imprvt. in Santa Barbara Co., Div. V, Route 2: Sec. E, Robt. Sherer, Los Angeles, $61,550.75; L. G. Garnsey, Los Angeles, $81,974.75; J. P. Fitzpatrick, Sacramento, $76,323.90; Conners, Green & Co., Eureka, $66,707.60; Sandercock Transfer Co., Inc., San Luis Obispo, $63,065; Conner Constr. Co., Los Angeles, $123,560; C. H. Hudson, Los Angeles, $69,742.10; Erickson & Peterson, Inc., San Francisco, $87,016.25; Ira Hodson, San Luis Obispo, $59,949.83. Solano Co., Div. III, Route 8: Sec. A, W. A. Dontanville, Salinas, $32,749; P. H. Hoare, Oakland, $32,577.50; Chitlock & Gorrill, San Francisco, $33,747.50; Harlan & Harlan, Williams, $26,976.75. Los Angeles Co., Div. VII, Route 4: Sec A, M. T. Shafer, Los Angeles, $43,500.50; Conner Constr. Co., Los Angeles, $34,850.50; Brashear-Burns Co., Hollywood, $28,093.30; D. M. R. Co., Inc., Los Angeles, $34,997.10; L. G. Garnsey, Los Angeles, $40,902.65. Almeda Co., Div. IV, Route 5: Sec. B, Whitlock & Gorrill, San Francisco, $39,272; E. H. Hoare, Oakland, $30,185.40; Bates, Borland & Ayer, Oakland, $29,306; T. M. Onley, Oakland, $33,964; The Western Constr. Co., Oakland, $33,627; W. J. Schmidt, Berkeley, $34,327; Tieslau Bros., San Francisco, $46,782.

CONTEMPLATED WORK.

Brooklyn, N. Y.—Queen's Park Commr., John Weier, will receive $25,000 to build a road from Neponsit to Government Reservation at Rockaway Point. Will be 25 ft. wide.

Burlington, Wis.—$17,000 available for improvement on the Sheridan Drive from Milwaukee to Racine, a stretch of about 5½ mi., hwy. to be 18 ft. concrete.

Clarinda, Ia.—City Council decided to pave 34¾ blks. this summer with either asphaltic concrete or bitulithic, or brick paving block.

Dayton, O.—City Commission authorized contract with E. D. Murray, Dayton, for paving Highland Ave. from Wayne Ave. to Wyoming St. with brick. Bid $28,259.85.

Fort Wayne, Ind.—Bd. of Works authorized pavements of 15 sidewalks, petition; improvements of 30 sts. ordered. Frank M. Randall, City Engr.

Frederick, Okla.—Paving for South 10th st. from south side of Calla Ave. to the north side of Astor Ave. was declared necessary by meeting of city council.

Gary, Ind.—$180,000 will be expended in street and highway extensions and imprvts.

Gates City, Va.—Lowell Dist. of Scott Co. voted to issue $45,000 road bonds. Address County Clerk.

Grand Rapids, Mich.—Cy. Engr. James R. Rumsey preparing plans and specif. for paving Plymouth Rd., from Weathy St. to Lake Drive, with bituminous macadam. Est. cost $12,000.

Great Falls, Mont.—It is proposed by the Cascade Co. Commrs. to gravel Sun River Road. Est. cost, $40,000.

Kansas City, Mo.—Plans for pavement of the Paseo, 47th to 63rd Sts., and Meyer Blvd. from the Paseo to Swope Park Entrance, a double stretch of rdway. 3 mi. long, were adopted by Park Board, and advertisement for bids authorized.

Livingston, Mont.—Park Co. will spend $60,000 on park road.

arksville, La.—$120,000 bonds to be used for road constr.

Martinsburg, W. Va.—Issue of $250,000 St. Imprvt. Bonds has been voted. Address City Clerk.

Mount Ayr, Ia.—Ringgold Co. will receive $40,000 from state and federal governments for road work.

Omaha, Neb.—Ordinance passed ordering improvement of that part of Redick Ave.

Contracting News

from 24th St. to Minne Lusa Ave. within St. Improvement Dist. No. 1546, by paving with asphaltic concrete class "B" and curbing with artificial combined curb and gutter. T. J. O'Connor, City Clerk.

Philadelphia, Pa.—Asst. Dir. Baldwin of Dept. P. W. received and scheduled proposals $650,000 hwy. imprvt. Principal imprvt. completing S. Broad St. plaza, $125,000.

Pocahontas, Ark.—Rd. Dist. No. 2 has been formed for purpose of building 35 mi. macadam rd. from Pocahontas to Missouri state line; cost about $125,000. J. D. Wells, Commr.

Portsmouth, O.—City Council ordained it necessary to improve 21st st. from west curb line of Timmonds Ave. to east property line of Summit St., by grading, setting curbs and gutters, constructing the necessary drains and retaining walls, paving the roadway with vitrified or hard-burned brick, constructing and laying cement sidewalks. Louis A. Zucker, Clerk.

Portsmouth, O.—City Council ordained it necessary to improve by paving, Massie St. from the south property line of Second St. to the north property line of Front St.; Armstrong Place, from the north line of Gallio St. to the north line of second alley north; Kendall Ave., from south property line of Gallia Ave. to north line of B. & O. Louis A. Zucker, Clerk.

Providence, R. I.—St. Hwy. from Sugar Loaf Hill to Matunuch Rd. about 3½ mi. long, with bituminous concrete. Estimated cost $478,000.

Raymond, Wash.—Co. Commrs. ordered special election for purpose of voting bond issue approx. $260,000 for constr. system of permanent highways.

St. Bernard, O.—May 31, 12 m., $70,000 street imprvt. bonds for purpose if improving Towney Ave., from Mitchell to Ross Aves.; Washington Ave., from Carthage Pike to Greenlee Ave.; Bertus St., from Delmae Ave. to Albert St.; Albert St., from Leonard to Zetta Aves.; Sullivan Ave., from Washington to Ross Aves.; Railroad Ave., from Carthage Pike to Ross Ave., by grading and resurfacing paving and setting curbs and repairing roadways. C. C. 5 per cent. W. L. Taylor, Audr.

St. Joseph, Mo.—Improvement of 4th St., Mitchell Ave., to Sacramento St., by repaving with brick blocks being prepared by City Engr Carl P. Hoff. Same being authorized by Bd. of Public Works.

Sioux Falls, S. D.—Resolution made by Bd. of City Commrs. deeming it necessary to grade Madison St. from Lincoln Ave. to the west boundary of the city. Also to grade alley in block 7, Summit addition. Walter C. Leyse, City Auditor.

Sioux Falls, S. D.—City Commission has passed resolution deeming it necessary to pave 20th St. from First Ave. to 7th Ave.; 10th St. from Phillips Ave. to bridge over the Big Sioux River; First Ave. from 12th St. to 21st St.; alley running east and west from Main Ave. to N. & S. alley in block 15, J. L. Phillips addition, also alley in blockade; alley in block 14, Bennett's first addition. Walter C. Leyes, City Auditor.

Waldron, Ark.—About 30 mi. macadam rd. to be built; cost, $160,000. J. S. Hill, Chairman.

Youngstown, O.—Ordinance passed to issue $15,000 bonds for purpose of street improvement.

Yankton, S. D.—Resolution made deeming it necessary to pave Lynn St. and 4th St. to 6th St. with either asphaltic concrete, bitulithic or Portland cement concrete. John W. Summers, City Auditor.

SEWERS.

BIDS REQUESTED.

Crookston, Minn.—June 12, 8 p. m., Office City Clk., bids will be recd. for constructing a 9-in. and 15-in. vit. c. p. sewer in Walsh St., between Central and Summit Aves.; and in Linden Ave., between Walsh St. and Summit Ave.; and in Summit Ave., between Linden and Riverside Aves. Plans and specif. on file. C. C. 10 per cent. Louis Ellison, City Clerk.

Kenyon, Minn.—June 8, 8 p. m., Vil. Rec. will receive bids for constr. sewers on Front St., Redwing, Pine, Langford and Holmes Sts., according to plans and specif. on file. C. C. 25 per cent. O. B. Strand, Vil. Recorder.

CONTRACTS AWARDED.

Albert Lea, Minn.—Illstrup & Olsen, of Minneapolis, awarded contract const. of sewer in Home addition, $10,947.31.

Fargo, N. D.—Contract for completion of the $50,000 sewer and water system for city of Garrison was let to Haggert Constr. Co., Fargo.

Grand Rapids, Mich.—Vander Wele Bros., 810 E. Fulton St., Grand Rapids, awarded contract for building storm sewer in East Grand Rapids, $10,865.

Omaha, Neb.—J. J. Hanighen awarded contract for completion of Saddle Creek storm sewer, between Marcy and Harney Sts.; cost, $62,689.35.

Piqua, O.—W. C. Kirschner & Son, Dayton, awarded contract for constr. Water St. sanitary and storm sewer; storm sewer $22,535, sanitary sewer $15,275, from Downey to Wayne, $1,025; total bid being $38,835.

River Falls, Wis.—City Council awarded Cast Stone Constr. Co., Eau Claire, contract for laying sewer on Main St. Cost of constr. est. between $20,026 and $25,000.

South Bend, Ind.—Bd. of P. Wks. has awarded Hoban & Rouch, South Bend, contract for trunk sewer on Portage Ave. Contract prices, $59,970. Trunk sewer system for High St. and Ewing Ave. was awarded to L. M. Webster Co. Sewer will be of vit. pipe. Contract price, $29,604.

Virginia, Minn.—City Council awarded Christopherson, 512 N. Second St., contract at $11,981.28.

CONTEMPLATED.

Gary, Ind.—Plans expending $420,000 for sewer constr.

Hamilton, O.—Cy. Engr., Frank Weaver, submitted estimate $11,089.20, install sanitary sewer in East Hamilton.

Little Chute, Wis.—Resolution was passed regarding the establishing and determining upon general sewer system in village. M. Van Hoof, Village Clerk.

Menominee,, Mich.—City Engr. T. R. Hasley is laying out plans for the constr. of a new sewer line which has been deemed necessary.

Northfield, Mich.—City Engr. F. O. Rice, has presented his plans and specif. for proposed West 1s and 2nd St. sewers.

Painesville, O.—Resolution declaring it necessary to improve Sanford St. beginning corporation line and running in an easterly direction to North State by constr. sanitary sewer of vit. p. reinforced with concrete together with necessary outlets. G. E. Guisewhite, Clerk.

Sioux City, Ia.—Resolution was made deeming it necessary to construct an 8-in. sanitary sewer in West Morning Side, to be more than 3 mi. long. Also considering constr. sanitary sewer in Nebraska St., between 23rd and 24th Sts. West 17th St., between West St. and a point opposite the east line Lot 4 in Block 4 of Coe Addition.

Sioux Falls, S. D.—Resolution adopted for constr. of a service connecting sewer on 20th St. from Phillips Ave. to 7th Ave. Walter C. Leyse, City Auditor.

Youngstown, O.—City Council ordained it necessary to improve following streets by constructing following sewers: Hunter Ave. between Japan St. and Campbell St.; Hillman St. from Indianola Ave. to South line city; Stamboy Ave. from Edwards St. to Hillman St.; Park Cliff Ave. from Hillman St. to west line city, lot 24029; Clearmount Drive from Edwards St. to W. side city lot 24091; Idelwood Ave. from Indianola Ave. to Ravenswood Ave.; Edwards St. from Indianola Ave. to Ravenswood Ave.; Butler Ave. between Salt Spring St. outlet 845; Manhattan Ave. between city lot 21682 and city lot 12027. M. F. Highland, City Clerk. F. M. Lilly, City Engineer.

Youngstown, O.—City Council ordained it necessary to improve Carlyle St. between Clifton St. and 350 ft. west of Wert St. by constructing a sewer. Smithfield St. between Manhattan Ave. and Belle Vista Ave., by constr. sewer. F. M. Lilly, City Engineer.

SEWAGE DISPOSAL PLANTS.

Ardmore, Pa.—Engr. Harrison, Mertz and Emlen, Commercial Trust Bldg., Philadelphia, making plans for local sewage disposal plant.

Allentown, Pa.—City planning for installation of sewage disposal plant. Chas. D. Weirbach, City Engr.

Barberton, O.—Council accepted bid of Central Saving and Trust Co. for bond issue of $250,000 for constr. sewage disposal plant.

Newark, N. J.—Bd. of Freeholders authorized immediate call for bids for reconstruction and imprvt. of sewage disposal plant at Overbrooke Hospital.

Weston, W. Va.—Legislature approved appropriation of $44,000 for installation of sewage disposal plant.

WATER WORKS.

CONTRACTS AWARDED.

Grand Rapids, Mich.—James R. Fitzpatrick has contract to build water works plant at Gobleville, Mich.

St. Marys, O.—Contracts approx. $47,000 for constr. of Municipal Light and W. Works Plants and distributing system including ornamental St. lamps, awarded by Bd. of Control to Skeldon Engineering Co., and National Supply Co., Toledo and Chas. I. Zahm, Detroit.

CONTEMPLATED.

Anamcose, N. D.—Civil Engr. T. R. Atkinson, Bismark, has been asked to prepare plans and specif. for installation of water works and sewage system of the town.

Barberton, O.—Supt. Long reports est. cost for installation of pump for new pumping station will be $61,000.

Camden, N. J.—Council approved bond issue of $45,000, for extensions and improvements in water system. Wm. D. Brown, Clerk.

Chardon, O.—The Mayor announces that in view of the passage of $58,000 water works bond issue, installation of water works system will proceed at once.

Canton, O.—Council decided to carry out recommendation of Engr. Chas. G. Burdick, Chicago, for improvements of water works system by installation of low lift pumps and the connecting by a main of the two groups of wells. Estimated cost $15,000.

Defiance, O.—F. G. Gettrost, Con. Engr., Kent, recommended to the Council that city build filtration plant and use the Maumee River as water supply. Roughly est. cost at $65,000.

Edgeley, N. D.—Engineer est. the total cost for contemplated water works and sewage system at $56,000.

Mansfield, O.—City council passed ordinance authorizing Dir. of Service to extend water works pumping station building $35,000.

Marshfield, Wis.—Petition for water main on N. Pale St. from C to D streets; and on South Maple St. from 9th St. to 100-ft. south of 11th street was granted. John Soubert, City Clerk.

Perth Amboy, N. J.—Bd. of Aldermen authorized $200,000 bond issue for extensions and improvements at water works; new pumping engines and buildings $53,000; new boiler and bldg. $35,000; suction lines $40,000; dams and spillways $15,000; trestle and coal pockets $20,000; wells and connections $20,000.

Pitman, N. J.—Boro council adopted ordinance for acquisition of plant and system Pitman Water Co., $48,000. Possession in July. Extension and imprvts. planned.

Riverside, N. J.—Special election called to vote bonds for $18,000 for Municipal Water system.

MISCELLANEOUS.

Bayonne, N. J.—City comm. planning for purchase of portable asphalt plant for municipal service. Est. cost $10,000. Wm. P. Lee, Cy.

Martinsville, Ind.—City council awarded contract for constr. new City Hall to W. W. Wilson, of this city, for $18,114.58.

Murray, Utah—City Commissioners plan purchasing of the Freeze and the Godfrey Groves for city park. Issuance of $60,000 for purchase of park and improvements.

Syracuse, N. Y.—Common council considering purchase of stone crushing plant for a municipal quarry. Est. cost $10,000.

Classified Dept

CLASSIFIED ADVERTISEMENTS PAY

If you are seeking employment, have second-hand machinery for sale, want to purchase machinery or supplies, want competent men to fill responsible positions, or have proposals to advertise, an ad. in these columns will put you in touch with responsible parties who can supply your wants.

RATES:

Want Ads. 1½ cents per word.
For Sale Ads. 25 cents per line.
Proposal Ads. 15 cents per line.
Minimum, 50 cents.

Rates on Display Ads. on Application.

Engineering Publishing Co.
INDIANAPOLIS, IND.

CITY MANAGER WANTED.

Goldsboro, North Carolina, invites applications for the position of city manager. Goldsboro is a progressive city of over 11,000 inhabitants, with healthful climate and good trade conditions—located on three railroads in the heart of the most fertile section of eastern North Carolina.

Applicant must have pleasing personality, good business judgment and broad vision. One posssessing qualifications of sanitary engineer preferred, though this is not absolutely essential.

Excellent opportunity for energetic man of ability to produce results.

Salary will probably range from $200.00 to $250.00 per month. Applications will be received up to July 1, 1917. Information and data furnished upon request.

CITY MANAGER COMMITTEE,
P. O. Box 461, Goldsboro, N. C.

NOTICE TO CONTRACTORS.

Sealed propoals for the improvement of two squares on Main street in the city of Shelbyville, Kentucky, will be received by the City Council until 6 p. m., June 7, 1917.

The work to be done involves approximately:

2,000 Cubic yards excavation.
5,500 Cubic yards surfacing.
925 Cubic yards concrete base.
100 Lineal feet 12-in. c. i. pipe.
75 Lineal feet 24-in. c. i. pipe.

Bids are asked for on three kinds of construction, brick, concrete and wood block on each square.

A certified check for $500.00 must accompany each bidder's proposal.

The right to reject any or all bids is reserved by the City Council.

Plans and specifications may be seen at the office of Commissioner of Public Roads, Frankfort, Kentucky, or City Engineer of Shelbyville, Kentucky.

CHAS. RANDOLPH, Clerk.

FOR SALE: An old subscriber to Municipal Engineering has for sale the first 39 volumes, unbound, 1890 to 1910 inclusive, and nine extra numbers. He will sell to the highest bidder, but expects at least $2 a year for them. Address MUNICIPAL ENGINEERING, 702 Wulsin Bldg., Indianapolis, Ind.

SANITARY AND STORM SEWERS.

Yuma, Arizona.

Bids will be received at the City Hall until 8 P. M., June 12th, for the construction of Sanitary and Storm Sewers; estimate cost, $30,000.

S. FRANK STANLEY,
City Clerk.

WANTED—Credit for two months' subscription to MUNICIPAL ENGINEERING or 20 cents in cash will be given to any one sending copy of any of the following back numbers to the publication office, Indianapolis, Ind., plainly marked so that the sender's name can be found:

July, 1907	September, 1911
April, 1910	October, 1911
October, 1910	October, 1912
December, 1910	December, 1915
January, 1911	April, 1916
May, 1911	

CALUMET SEWAGE PUMPING STATION EQUIPMENT.

THE SANITARY DISTRICT OF CHICAGO
Chicago, Ill.

Sealed proposals, endorsed "Proposals for Pumping Equipment at Calumet Sewage Pumping Station," will be received by the Clerk of The Sanitary District of Chicago at the office of said District, Room 700, Karpen Building, 910 South Michigan Avenue, Chicago, Illinois, until 12 noon, standard time, on Thursday, June 28th, 1917, and will be opened publicly by the Board of Trustees of said Sanitary District at a meeting to be held on that day or at the first meeting thereafter.

The work for which tenders are invited includes the furnishing, delivering and installing of equipment as follows:

Division A—Six (6) vertical centrifugal pumps, of nominal capacity, one (1) at 50 c.f.s., two (2) at 75 c.f.s., three (3) at 275 c.f.s.

Division B—Three (3) vertical synchronous-induction motors and three (3) vertical induction motors ,prime movers for above pumps).

Division C—Two (2) turbo-generator units with accessories, of nominal capacity each of 3,000 K.W.

Division D—Eight (8) water tube boilers, with furnaces, chain grate stokers, steam superheaters, and soot blowers, of nominal rating each of 500 horsepower.

The equipment under each of the above divisions is to be furnished and erected complete, with appurtenances, as specified, at the Calumet Sewage Pumping Station of The Sanitary District of Chicago, Chicago, Ill.

Proposals may be made on one division or any number of divisions, complete, but not on part of the items under any one division.

All proposals must be made upon blank forms of proposal furnished by said Sanitary District and shall be made in accordance with and to conform to all of the terms and conditions set forth in the "Requirements for Bidding and Instructions to Bidders," attached thereto. Specifications, forms of proposal and drawings may be obtained upon deposit of ten dollars ($10.00) at the office of said Sanitary District, which sum so deposited shall be refunded if said plans and specifications are returned in good condition within thirty days following the opening of bids.

Each proposal must be accompanied by a certified check on a responsible bank doing business in the city of Chicago, or cash, to the amount or amounts as follows:

Division A, ten thousand dollars ($10,000.00).

Division B, ten thousand dollars ($10,000.00).

Division C, twelve thousand dollars ($12,000.00).

Division D, twelve thousand dollars ($12,000.00).

The Board of Trustees of The Sanitary District of Chicago reserves the right to reject any and all proposals.

THE SANITARY DISTRICT
OF CHICAGO,
By JOHN McGILLEN, Clerk.
Chicago, May 16th, 1917.

VITRIFIED BLOCK PAVEMENT.

Harrisburg, Penn.

Pennsylvania State Highway Department.—Sealed proposals will be received at said office until 10 a. m. June 12, 1917, when bids will be publicly opened and scheduled and contracts awarded as soon thereafter as possible, for the reconstruction of 1,270 lineal feet of Vitrified Block pavement 26 feet wide, situated in Swatara township, Dauphlin County, State-aid Application No. 570; 14,128 lineal feet of Vitrified Block pavement, 16 feet wide, situated in Clarion and Paint townships, Clarion county, State Highway Route No. 65; 32,923 lineal feet of Vitrified Block and Reinforced Concrete pavement, 16 feet wide, situated in Jackson and East Taylor townships, Cambria county, on State Highway Route No. 52, and 36,170 lineal feet of Vitrified Block and Reinforced Concrete pavement, 16 feet wide, situated in Cecil and North Strabane townships, Washington county, and South Fayette township, Allegheny county, on State Highway Route No. 108. Plans and specifications may be seen at office of State Highway Department, Harrisburg, 1001 Chestnut Street, Philadelphia, and 904 Hartje Building, Pittsburgh, Pa. Full particulars and information on application to Frank B. Black, State Highway Commissioner.

WATER-WORKS IMPROVEMENTS.

Kendallville, Ind.

Notice is hereby given that the Common Council of the City of Kendallville, Indiana, will receive sealed bids and proposals for the furnishing of materials and construction of the following improvements to the Municipal Waterworks System in said City, according to the plans, drawings, profiles and specifications now on file in the office of the City Clerk of said City, until one o'clock P. M. on the 12th day of June, 1917:

500,000 Gal. Reinforced Concrete Covered Reservoir 40 ft. x 85 ft. x 20 ft.

1 Motor Driven Low Service Centrifugal Pump, capacity 350 G. P. M., total lift 70 feet.

1 Motor Driven Domestic Service Centrifugal Pump, capacity 400 G. P. M., pressure 60 lbs., and

1 Motor Driven Fire Service Centrifugal Pump, capacity 1,000 G. P. M., pressure 100 lbs., or

2 Duplicate Motor Driven Centrifugal Force Pumps, capacity 700 G. P. M., each, pressure 60 lbs.

Piping, Valves and Fittings.

Each bid shall state the prices in words and figures on the blanks provided therefor, and said bid shall be enclosed in sealed envelope marked "BID FOR WATERWORKS IMPROVEMENTS," and addressed to the said City Clerk. Each bid shall contain the full name of every person or company interested in it.

Each bidder must file with the said City Clerk, when he files his bid, the usual statutory affidavit, and deposit with him a certified check upon a solvent Bank, payable to said City, in the sum of 10 per cent. of said bid, as a guaranty that he will accept said bid and carry out the construction of said work. The successful bidder will be required to give a bond within 10 days from the date of award of contract with surety to be approved by the said Common Council, insuring the faithful completion of said work according to contract.

The Common Council reserves the right to reject any and all bids, and readvertise said work.

By order of the Common Council of the City of Kendallville, Indiana, this 15th day of May, 1917.

O. E. MICHAELIS, City Clerk.
GEORGE CHAMPE, Civil Engineer,
Toledo, Ohio.